plating

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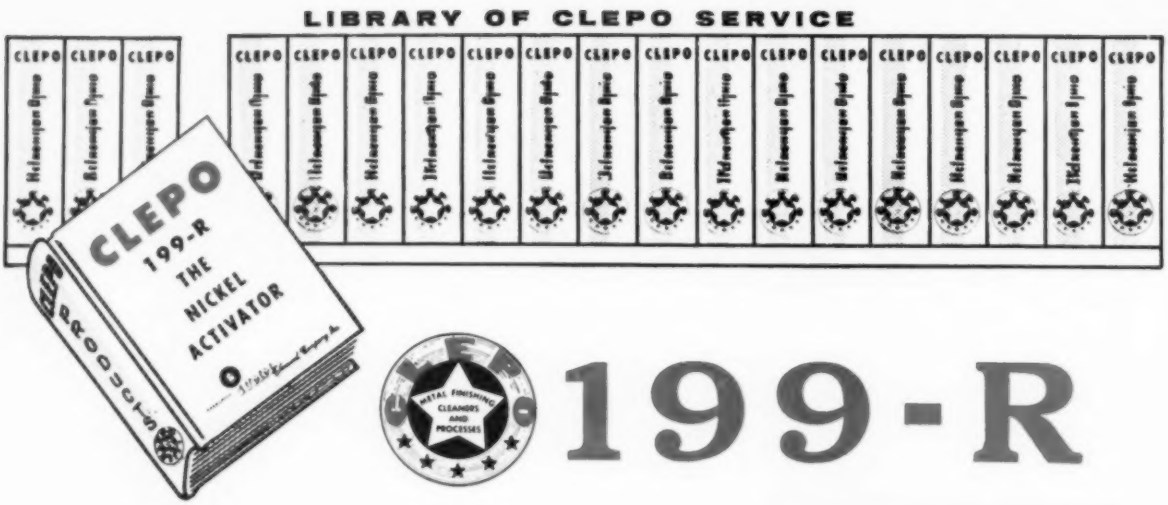
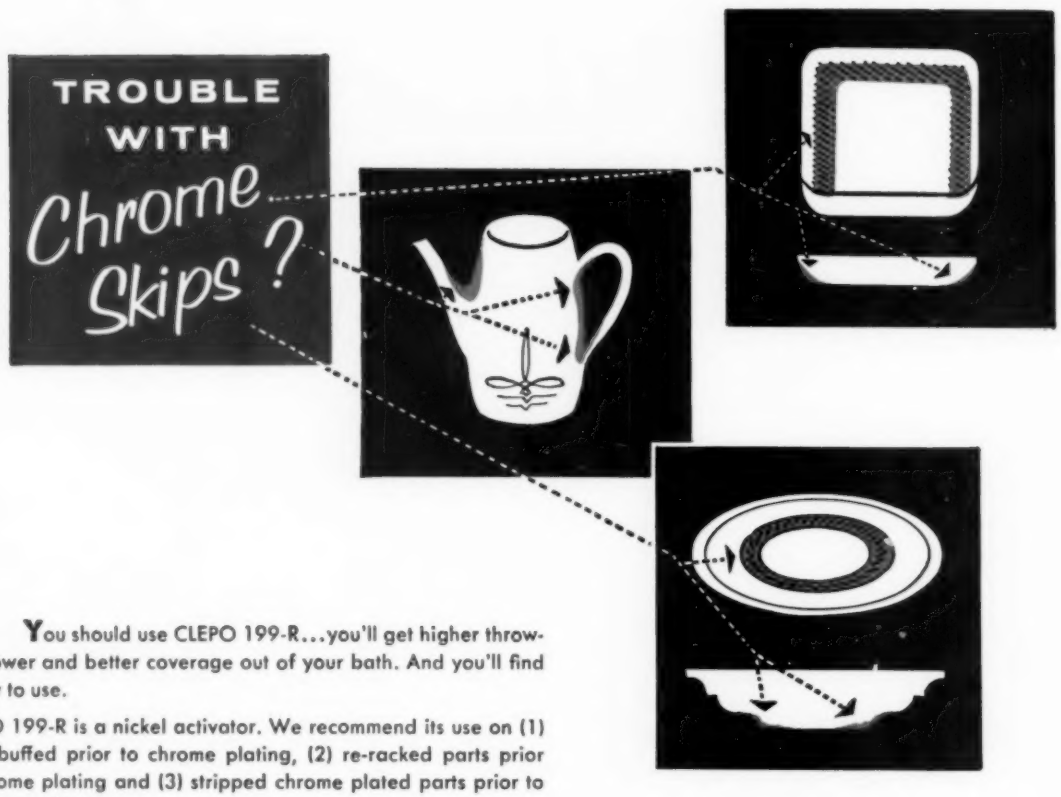
Ann Arbor, Michigan

SEPTEMBER 1958



199-R



You should use CLEPO 199-R...you'll get higher throwing power and better coverage out of your bath. And you'll find it easy to use.

CLEPO 199-R is a nickel activator. We recommend its use on (1) parts buffed prior to chrome plating, (2) re-racked parts prior to chrome plating and (3) stripped chrome plated parts prior to re-chrome plating.

We'll be glad to send you a working sample. Better yet, ask to have a CLEPO Field Service man call with a sample to show you how efficient CLEPO 199-R is in improving chromium plating operations.

CLEPO 199-R is but one of many formulations developed in CLEPO Laboratories for cleaning, stripping, barrel finishing, and aluminum etching.

FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

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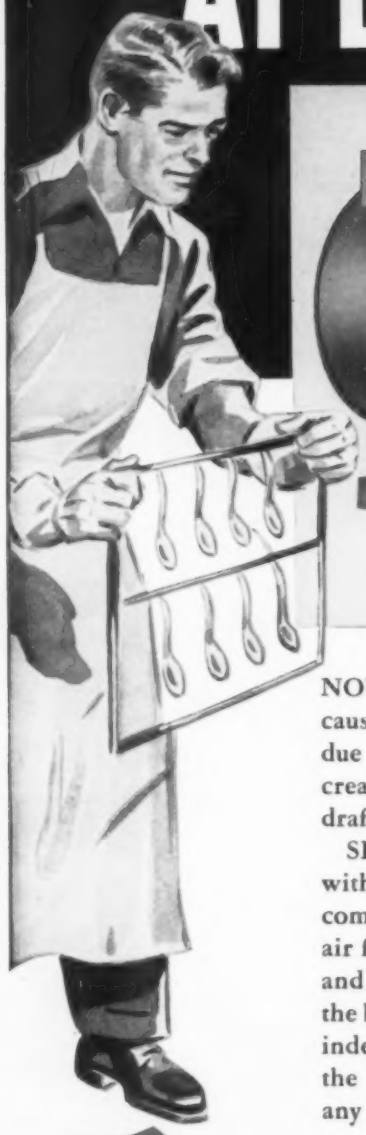
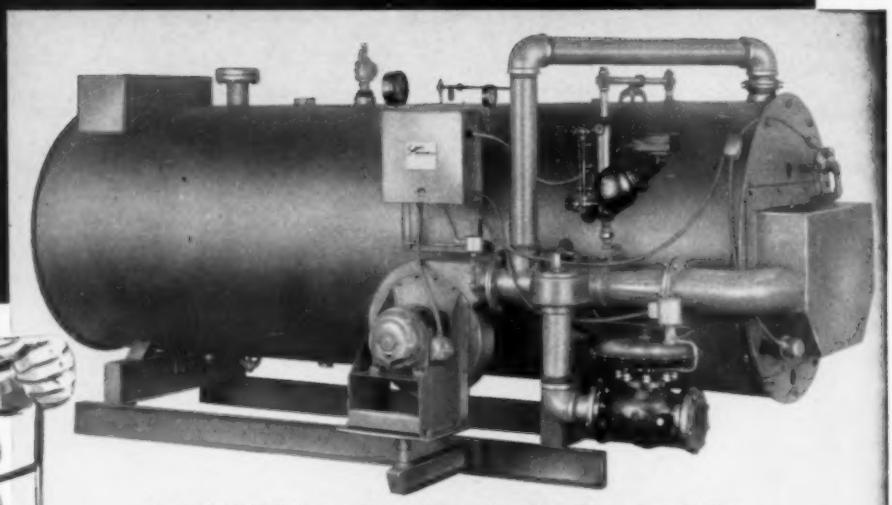
58-1

AT LAST A BOILER DESIGNED FOR THE PLATER!





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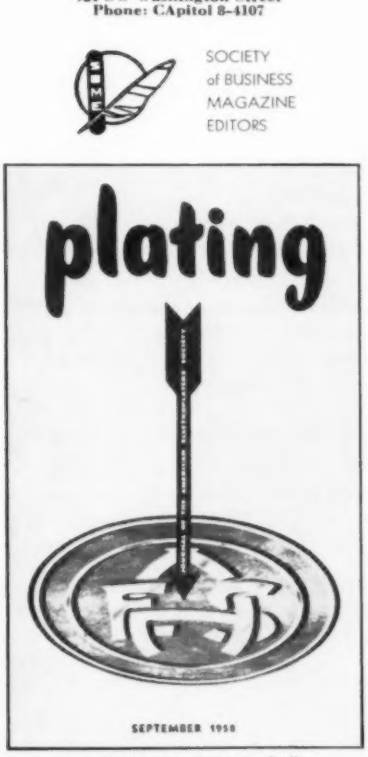

Cover Designed by James A. Civille.

plating

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

September 1958 — Vol. 45, No. 9

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Harshaw Announces *Another Addition*
to its growing family of Bright Nickel Plating Processes

HARSHAW

The Harshaw Chemical Company has developed the SUPER NIBRITE BARREL BRIGHT NICKEL PROCESS to produce a lustrous and ductile nickel deposit by the use of only two brighteners, both of which are liquid addition agents. These addition agents are non-metallic, organic type brighteners designated as BBN #1 (the primary brightener) and BBN #2 (the secondary brightener).

Among the many advantages of the SUPER NIBRITE BARREL NICKEL are its superior brightness, excellent leveling, ductility, ease of operation and control, tolerance to organic and metallic impurities, and its receptiveness to chrome plating.

Harshaw

Super NIBRITE

Barrel Bright Nickel Process

Brightness. The SUPER NIBRITE nickel plate is bright over a wide range of current densities and temperatures.

Leveling and Ductility. For a barrel nickel the SUPER NIBRITE nickel plate has amazing leveling and ductility over its entire operating range.

Ease of Operation and Control. The recommended operating conditions for SUPER NIBRITE nickel are a pH of 4.0-5.0 and a temperature of wide range up to 140°F. The BBN #1 concentration can be high without any ill effect on the operation of the bath and since it is lost mainly only through drag-out, additions can be made in proportion to the nickel salts added to replace drag-out losses. The amount of BBN #2 used in any specific installation varies with the type of work, finish of the base metal, and the required finish. Additions can be made with ease prior to the end of plating time.

Tolerance to Impurities. SUPER NIBRITE solutions remain ductile and bright over long periods of operation due to the high tolerance of the solution to both organic and metallic impurities. There are no unusual breakdown products from the organic brighteners themselves and thus any measures taken to avoid severe contamination will result in trouble-free operation. Also carbon treatments and filtrations, if necessary, can be performed without undue loss of the brighteners.

Extended Periods of Idleness. SUPER NIBRITE baths can be operated after extended periods of idleness without sacrificing loss of brightness or ductility.

Speed. The greater conductivity and faster plating rates obtained by operating the solution at 140°F can be used to great advantage by reducing the plating time for a desired finish up to 50%.

Contact the Harshaw Branch nearest you. Harshaw representatives will be happy to discuss with you the application of this process in your plant.

The Harshaw Chemical Co.

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EDITORIAL

"A GOLDEN OPPORTUNITY"
The AES Golden Anniversary

THE FIFTY-YEAR GROWTH of our Society has, in itself, proved to all that it has been a worthwhile organization, worthy of the dreams and efforts of our Founders. All through the years, the faithful members who make up the Branches and the activities of these Branches have been the outstanding reasons for our continued growth. It takes individuals to make up a Branch, but it takes an active Branch with a good educational program to hold the old members and attract new ones.

Our new Educational Committee has been operating for just one year, but in this year, many good projects which will be of great assistance to the Branches have been started. The present Speakers List was very aptly compiled by I. William Marcovitch of the Philadelphia Branch, but it becomes the duty of the Committee to keep it up to date. This list will make it possible for the Branches to maintain the high level of their educational meetings. Outlines, books and even a complete electroplating course will ultimately become available to those who wish to put on a course for its members and prospective members. All possible help and aids for the Branches toward the realization of a top-notch program is the aim of this Committee and the National Office.

The July issue of PLATING MAGAZINE started the flow of data and information pertinent to the celebration of our Golden Anniversary Year, and much more is to come. Now is the time for each Branch to take advantage of this Golden Opportunity! Use the theme of our Anniversary at your meetings! Tie it in with your educational program! Make the members aware of it! Use it as a selling point for new members! Comprehensively, point the entire year's planning toward the Golden Jubilee Convention and Industrial Finishing Exposition and the Fifth International Conference on Electrodeposition and Metal Finishing to be conducted in Detroit next June.

A chance such as this comes just once in a lifetime and every effort should be extended to take full advantage of it as a means toward more service to our membership, strengthening our Branches and making our Society the Society we all hope it to be.

Make the best of this *Golden Opportunity!!*

Ralph D. Wysong

First Vice President

◀ INDICATE A 903.

Now . . . an extra plus that keeps anodes clean!

For years McGean Cast Carbonized Nickel Anodes 99% plus have been first choice of many discriminating users. Consistent, dependable high purity, coupled with our manufacturing "know how", has given consumers freedom from worry when Besplates were employed in their Nickel Plating operations.

Good as they were, we continued to seek possible improvements and through research we are now pleased to announce two important developments.

1. Besplates are now electrolytically treated just prior to shipment in a novel manner providing a chemically clean silvery surface to each and every anode. No longer will there be any need for platers to clean anodes after arrival to avoid introduction of oils, greases or dirt into plating solutions.

2. A valuable product deserves an attractive package. McGean now supplies Besplate Nickel Anodes in a handsome container, so designed to deliver in perfect condition those chemically clean anodes produced in our new process. The container is strong, contents well marked, capable of easy stacking for storage and a real space saver. Your Plating Department is sure to approve of the neat, clean manner in which McGean Besplate Nickel Anodes reach your plant.

USE . . .
McGEAN Besplate Nickel Anodes

All other types of McGean Nickel Anodes are now in the new packaging unit. This includes recast anodes made from your Scrap. We are skilled in the art of refining and casting Scrap Nickel.

McGEAN

THE McGEAN CHEMICAL COMPANY

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PLATING MAGAZINE HAPPILY ANNOUNCES . . .

THE American Electroplaters' Society (AES) observes its Fiftieth Anniversary from July 1, 1958 through June 30, 1959.

NOT only will that observance be climaxed by the Golden Jubilee Convention and Industrial Finishing Exposition, including the Fifth International Conference on Electrodeposition and Metal Finishing, to be held in Detroit, June 14-19, 1959 with the AES's Detroit Branch as host BUT ALSO by PLATING MAGAZINE'S Golden Jubilee Issue to appear in June 1959.

A LARGE feature issue beamed both for immediate interest to PLATING'S global circulation and for long retainment as an AES reference source and as a memento of this once-in-a-lifetime, year-long observance, this issue will provide advertisers with a unique opportunity to reach the vast purchasing power in this field served by PLATING MAGAZINE, AES's official journal.

DEMAND for advertising space looms large, both for institutional and product advertising. Assure yourself of accommodation by placing your insertion order NOW, particularly for special, preferred or premium positions.

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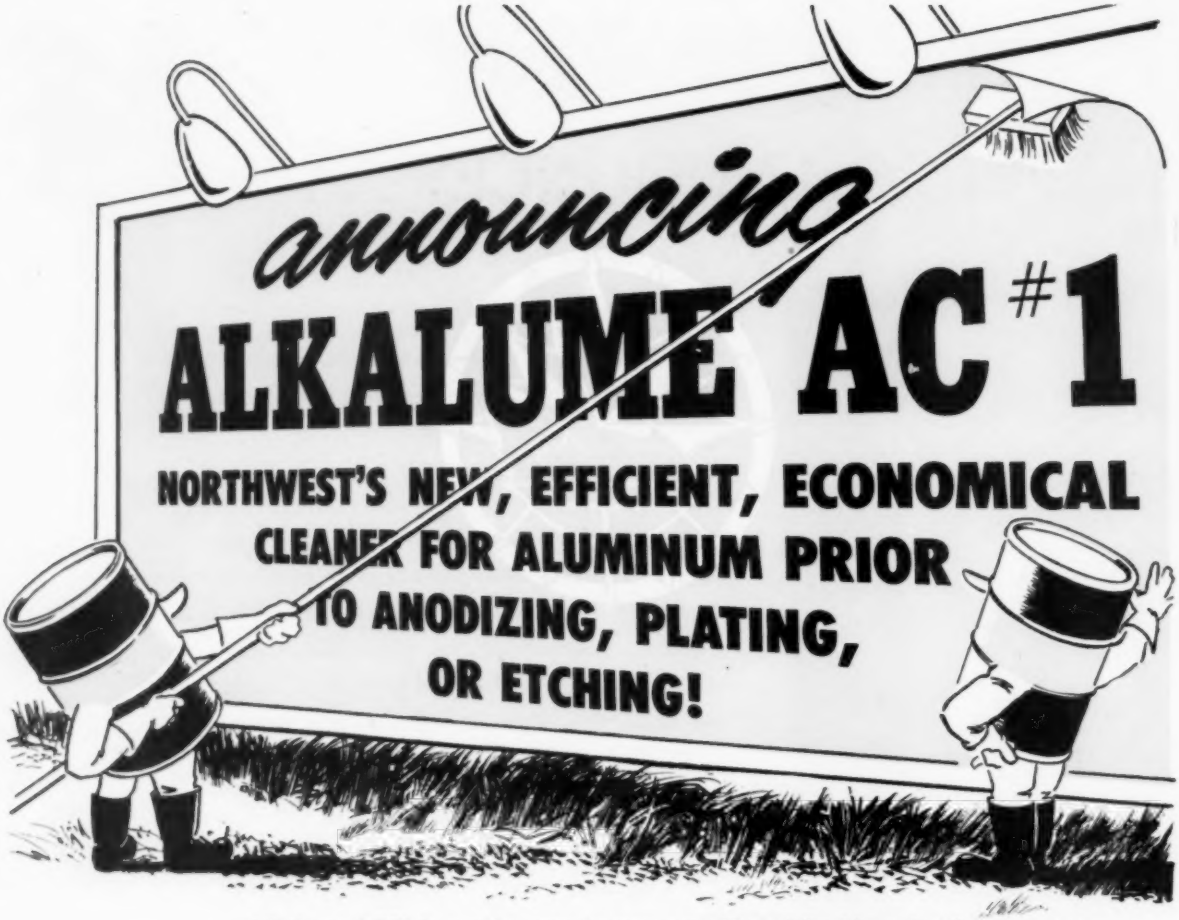

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Fast work . . . roughing the box ends of 1½" combination wrenches with 50-X RESINALL METALITE "91" Coat Cloth Belt.

Cuts "roughing" time in half!

Here's the newest, roughest, toughest, fastest-working abrasive for the metalworking industry — "91" Coat RESINALL METALITE Cloth. It's the answer to your demand for more production plus more mileage. And a "91" Coat Abrasive Belt cuts faster.

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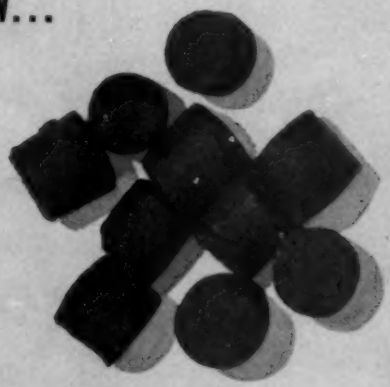
A-5

NEW...

ALUMINUM OXIDE TUMBLING NUGGETS

Fused Aluminum Oxide Tumbling Nuggets provide a fast cutting action for grinding, deburring, and polishing and require no breaking-in period. Their long wearing qualities help minimize the problem of lodging in parts. They are designed especially for precision barrel finishing.

NEW...

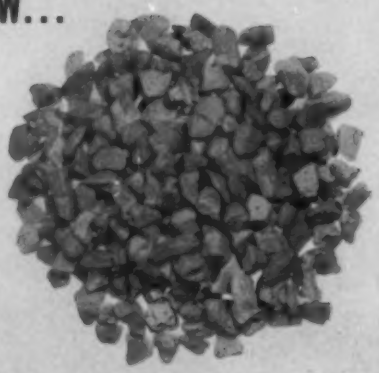


ALUMINUM OXIDE VITRIFIED TUMBLING PELLETS

Aluminum Oxide Vitrified Tumbling Pellets are controlled bonded shapes manufactured under the same rigid quality standards as other bonded abrasive products. The grit, grade, and bond are precisely formulated to give maximum "cut" with minimum wear. They are particularly advantageous where lodging must be prevented and where a rapid rate of cut is desired.

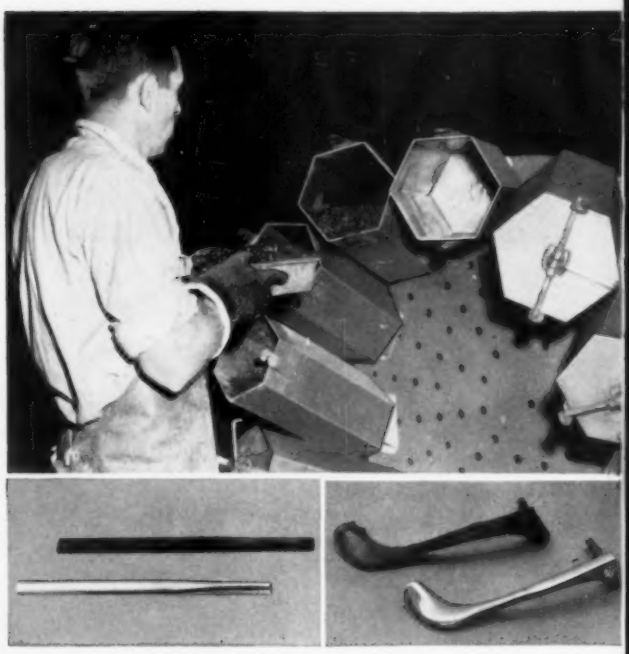
NEW...PRECISION-CONTROLLED...

NEW...



"CARBO-BRITE"

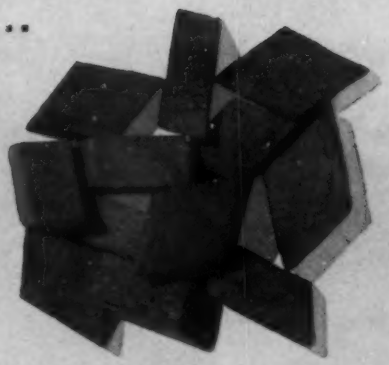
An electric furnace product having a fine crystalline structure and slow wearing qualities which adapt it to light burr removal and high finish operations where high color is desired. Its weight, somewhat heavier than nuggets, makes it specially suited for burnishing operations.



Typical Parts Finished with CARBORUNDUM *Tumbling Media Showing "Before and After" Illustrations.*

In Canada: Behr-Manning (Canada) Ltd., Brantford. For Export: Norton Behr-Manning Overseas Inc., Troy, N. Y., U. S. A.

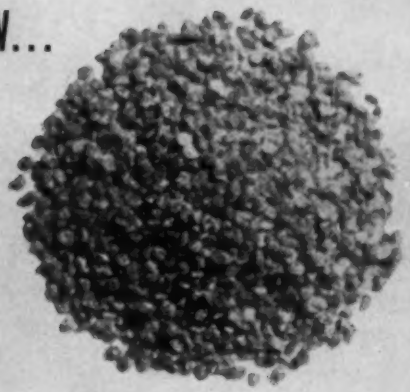
NEW...



"CARBO-RUBS"—RUBBER BONDED TUMBLING MEDIA

"Carbo-Rubs" are parallelogram-shaped rubber bonded tumbling media. They are used primarily where the burr is light and action must be gentle. Their most popular use is to prepare a surface for high "color" and remove burrs from non-ferrous parts.

NEW...



ALUMINUM OXIDE TUMBLING GRAIN

Aluminum Oxide Tumbling Grain is Fused Aluminum Oxide specifically designed for the most economical results in tumbling small metal parts. It may also be used as an additive to augment the cut of various other tumbling media. Coarser sizes are used in the new "spinner-type" finishing equipment. Available in a wide range of types and grit sizes.

...TUMBLING MEDIA

for all barrel finishing operations... deburring...

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Faster, More Uniform Metal Finishing At Low Cost

Manufacturers of metal parts which require deburring, scale removal, polishing, honing, blending, or burnishing operations can now produce finer finishes *at lower costs* by using the new *precision-controlled* Tumbling Media by CARBORUNDUM. New improvements in the manufacture of abrasive media at CARBORUNDUM assure exceptionally high output per barrel with absolute uniformity of parts and finishes. Even unusual shapes and sizes can be mass-finished to precision tolerances... at a fraction of the time and cost... thanks to precision-controlled tumbling abrasives by CARBORUNDUM. CARBORUNDUM'S wealth of abrasives 'know-how' is readily available to assist manufacturers in working out their specific parts finishing problems. Write for further information.

MAIL THIS COUPON TODAY

Write for this FREE Booklet A practical guide describing barrel finishing of metallic parts on a mass production basis using Tumbling Media.

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Dept. PL83-816
Niagara Falls, New York

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Company_____

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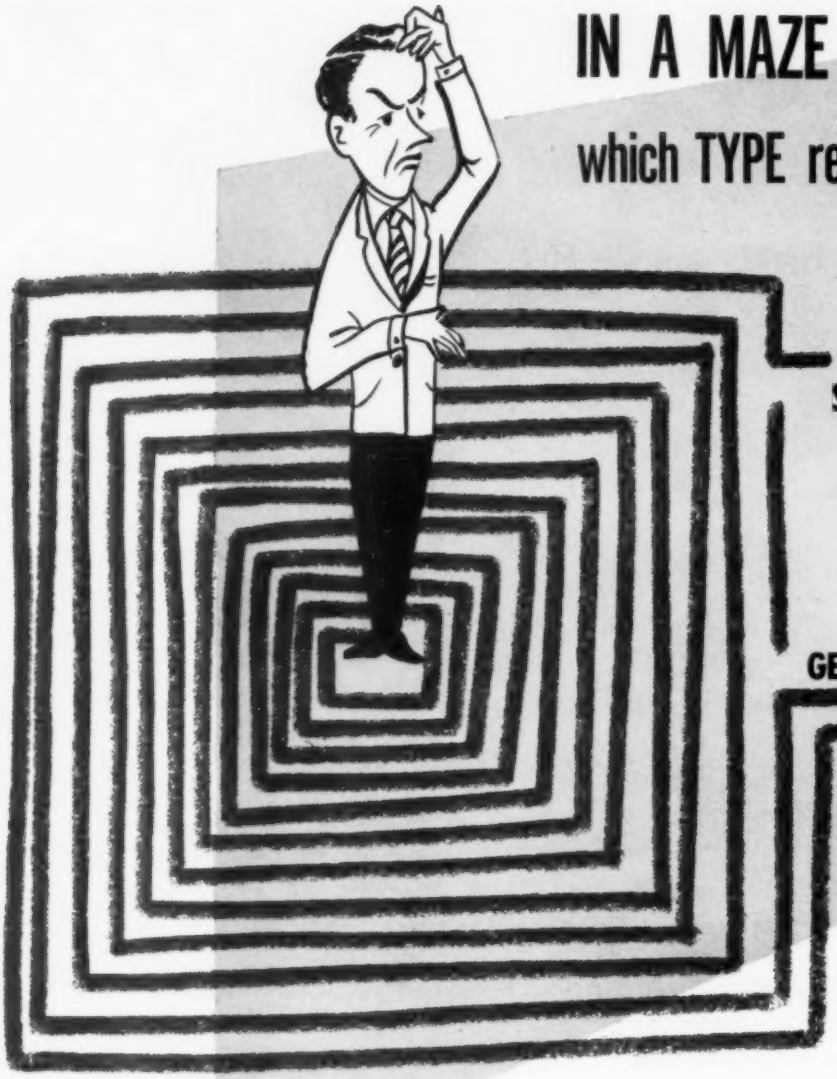
City_____ Zone____ State_____

For expert advice... Ask the Man from

CARBORUNDUM

REGISTERED TRADE MARK

IN A MAZE when deciding which TYPE rectifier to buy?



Why not call RAPID'S engineering department with your power requirements. Let us match your requirements with the right type rectifier.

Because each semi-conductor has advantages to offer, and because RAPID supplies *all three*, you can be certain of obtaining sound technical advice.

Call TA 8-2200 for reliable technical service.

THE NAMEPLATE THAT MEANS *"More Power to You!"*

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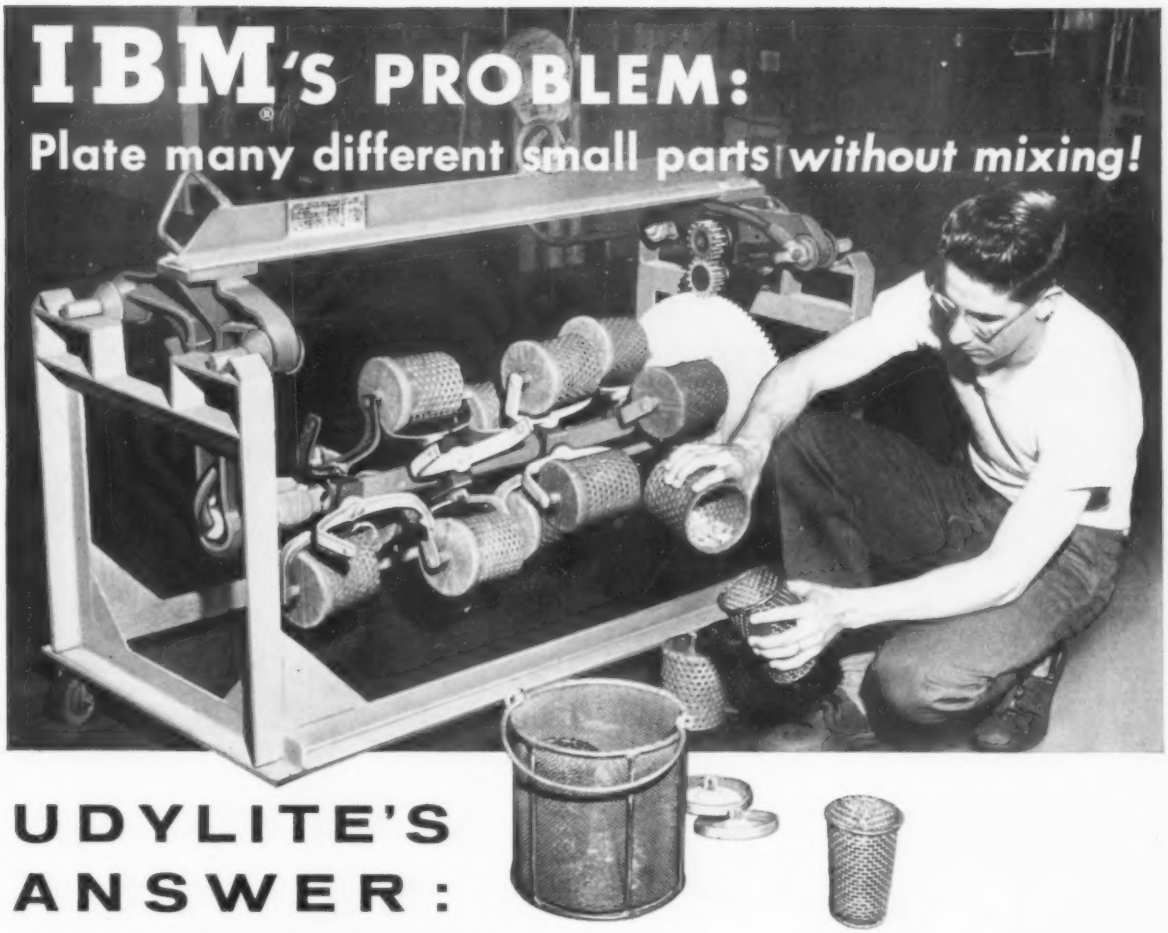
IBM'S PROBLEM:

Plate many different small parts *without mixing!*



UDYLITE'S ANSWER:

CLUSTER BARRELS . . . for faster, greater production!

At the International Business Machines Corporation, Electric Typewriter Division plant, at Lexington, Ky., many different small parts had to be plated and processed uniformly . . . without mixing. Conventional methods proved too slow, costly and inaccurate. Then, IBM discussed the problem with Udylite.

Out of this discussion came the Udylite Cluster Barrel—developed specifically for the plating and processing of many different minute parts simultaneously . . . *and doing it without mixing!*

Also, because of the gentle tumbling action of the work in each barrel, IBM is now able to plate tiny, fragile parts that heretofore had to be racked, thus saving thousands of dollars each year.

And, the excellent agitation of the solution that results from the orbit struck by each barrel, plus the definite replenishing of the solution makes the Udylite Cluster Barrel the ideal answer for such a problem.

In addition to the multiple cluster illustrated, Udylite now offers 12, 8 and 4 barrel units for plating any number of small and medium sized parts. These cluster combinations are indispensable for anyone engaged in the production plating or processing of business machines, radios, electrical and electronic items.

If processing of small batches or volume plating *without mixing* is a problem in your shop contact your local Udylite salesman now. He can show you how Udylite Cluster Barrels can be *your* answer, too! Call him today or write direct to:

the udylite corporation

detroit 11, michigan • world's largest plating supplier

NEW Electrocleaner with chelating action!

Now available—Oakite 190—a wonderful reverse current cleaner that's far ahead of existing products. See what Oakite 190 removes by chelating: smut, fingerprints, light rust bloom, even light oxides such as weld marks. This superior cleaning-chelating action cuts plating rejects, can often eliminate some pre-cleaning steps.

What's so good about Oakite 190? It has high electrical conductivity. It has excellent wetting, penetrating and emulsifying action. It provides controlled foam blanket. Fine smut-removal action. Water-softening ability. High chromic acid tolerance. Chelating action. Long, effective solution life.

Ask the local Oakite man to tell you all about Oakite 190. Meanwhile send for data sheet. Oakite Products, Inc., 40 Rector Street, New York 6, N. Y.

in our 50th year

SPECIALIZED INDUSTRIAL CLEANING
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MATERIALS · METHODS · SERVICE
SCIENCE

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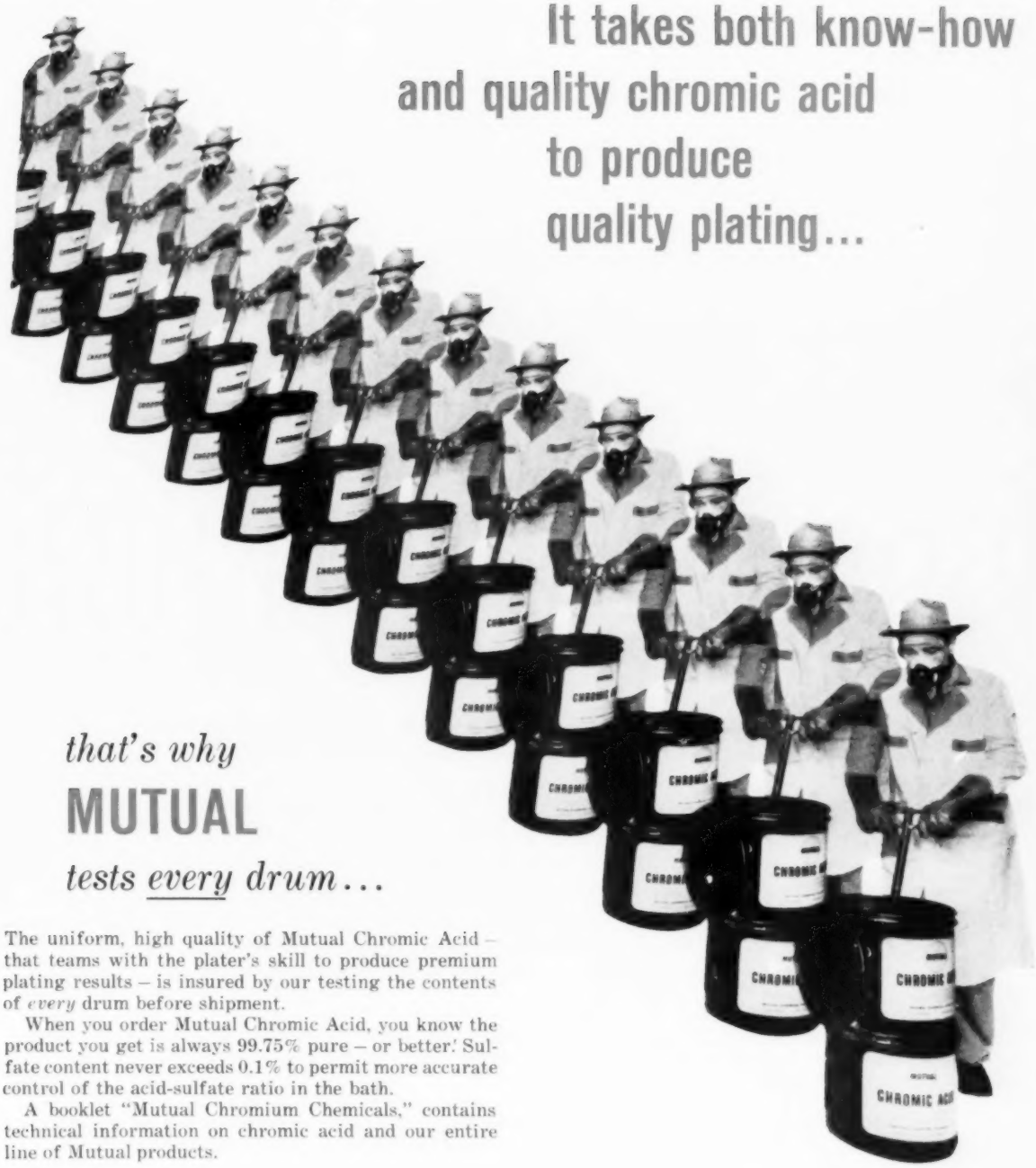
It takes both know-how and quality chromic acid to produce quality plating...



that's why

MUTUAL

tests every drum...

The uniform, high quality of Mutual Chromic Acid – that teams with the plater's skill to produce premium plating results – is insured by our testing the contents of *every* drum before shipment.

When you order Mutual Chromic Acid, you know the product you get is always 99.75% pure – or better. Sulfate content never exceeds 0.1% to permit more accurate control of the acid-sulfate ratio in the bath.

A booklet "Mutual Chromium Chemicals," contains technical information on chromic acid and our entire line of Mutual products.

Mutual chromium chemicals

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Sodium Chromate
Chromic Acid

Potassium Bichromate
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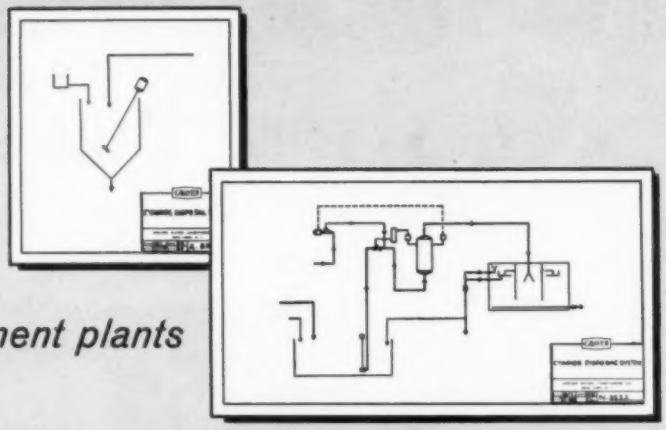
CITY_____ ZONE____ STATE_____

from simple units...



...to complex treatment plants

GRAVER SYSTEMS ASSURE

POSITIVE CYANIDE DISPOSAL

From simple batch units to continuous treatment plants, Graver Cyanide Disposal Systems are engineered to provide— ★ POSITIVE DISPOSAL

★ SAFETY

★ SIMPLICITY

★ MINIMUM MAINTENANCE

★ LASTING ECONOMY

Graver Systems include equipment for oxidation of cyanide to cyanate or complete cyanide destruction by either batch or continuous disposal.

The complete line of Graver equipment for the treatment of cyanide *and all other plating wastes* includes Reactivators®, Rota-Rake® Sedimentation Basins, Ion Exchangers, and specially designed batch treatment units with all controls and accessories.

Whether your problem is cyanide, chromate, acid, alkali or any combination of wastes, Graver know-how, based on years of successful waste treatment experience, will provide the perfect answer in the form of integrated, efficient systems job-engineered to individual plant needs.

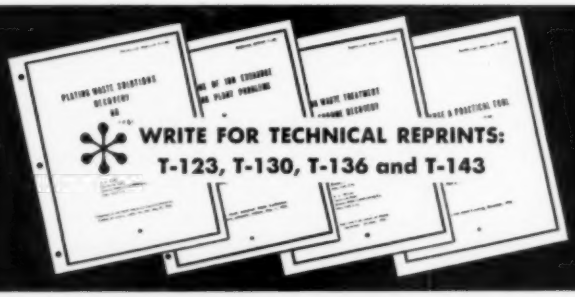
GRAVER®

Industrial Waste Treatment Dept. W-521

GRAVER WATER CONDITIONING CO.

Division of Union Tank Car Company

216 West 14th Street, New York 11, N. Y.



WRITE FOR TECHNICAL REPRINTS:
T-123, T-130, T-136 and T-143

HANDY GUIDE TO CHROMATE DIPS

Line of Unichrome Dips offers unusually wide choice
... permits proper matching of solution with product and production needs

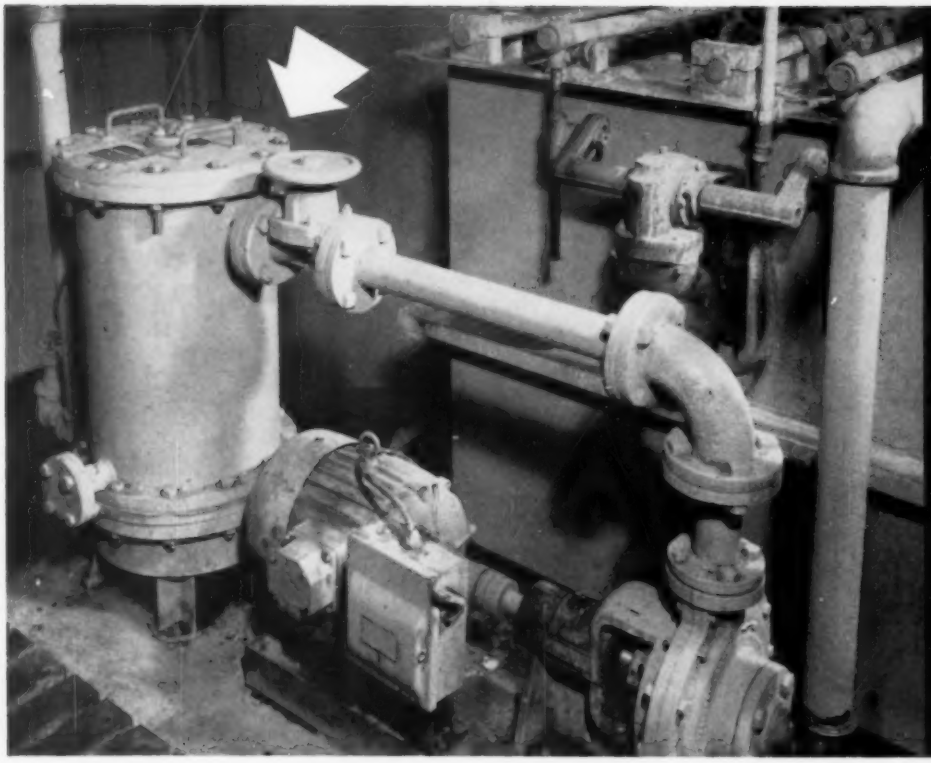
Conversion coatings for metals are formed integral with the surface, and improve a product's appearance and corrosion resistance at surprisingly low cost. No single chromate solution satisfies all conversion coating needs. This chart shows what you can get. It is a partial listing covering chemical conversion coatings for zinc. There are still other Unichrome chromating compounds for cadmium and other metals.

In addition, Metal & Thermit offers its long experience in plating and finishing processes, through its highly qualified service engineers. Send for complete Unichrome Pick-A-Dip Chart.

UNICHROME

METAL & THERMIT CORPORATION
GENERAL OFFICES: RAHWAY, NEW JERSEY
Pittsburgh • Atlanta • Detroit • E. Chicago • Los Angeles
In Canada: Metal & Thermit—United Chromium of Canada, Limited, Rexdale, Ont.

METAL SURFACES	COLOR AND PROPERTIES OF FINISH	UNICHROME DIP COMPOUND	METHOD OF APPLICATION	SALT SPRAY RESISTANCE (TO WHITE CORROSION)	MEETS U.S. GOV'T. SPECS	TYPICAL APPLICATIONS
Zinc Plate or Galvanized	Bright, chromium-like finish, high corrosion protection, resistant to finger printing, tarnish, stain.	95 (liquid) or 1081 (solid)	Manual dipping & alkaline leach	50 hours or more	USA 57-0-2C Type I	Toys, appliance, aircraft & bicycle parts, tools, wire goods, quality hardware.
	Bright, chromium-like finish, maximum clarity, high eye-appeal, good corrosion protection.	98 (liquid) or 1082 (solid)	Manual or automatic; alkaline leach; (98 permits hot water leach)	50 hours or more	USA 57-0-2C Type I	Toys, appliance, aircraft & bicycle parts, tools, wire goods, quality hardware.
	Bright, chromium-like finish, highly economical, good eye-appeal, good corrosion protection.	99 (liquid) or 1084 (solid)	Manual or automatic; alkaline leach	50 hours or more	USA 57-0-2C Type I	Toys, appliance, aircraft & bicycle parts, tools, wire goods, quality hardware.
	Bright, clear finish, maximum economy.	1090 (liquid) or 1085 (solid)	Manual or automatic; no leach	10 to 50 hours	None applicable	High tonnage bulk work, automotive, electrical.
	Iridescent yellow finish, excellent paint base at low cost, maximum corrosion protection.	95 (liquid) or 1081 (solid)	Manual or automatic; no leach	More than 100 hours	USA 57-0-2C Type I QQZ-325 Type II QQP-416 Type II	Appliance & business machine parts, conduits, lock hardware.
	Dark, iridescent yellow finish, maximum corrosion protection, excellent low-cost paint base.	1071 (liquid) & 1071A (liquid)	Manual or automatic; no leach	More than 100 hours	USA 57-0-2C Type I QQZ-325 Type II QQP-416 Type II	Hardware, marine, appliance parts.
Zinc Plate	Bright, brass-like finish, maximum corrosion protection. Usually coated with clear lacquer.	1075 (liquid)	Manual or automatic; no leach	More than 100 hours	USA 57-0-2C Type I QQZ-325 Type II QQP-416 Type II	Hardware, wire goods, wheel goods, toys.
	Olive drab finish, maximum corrosion protection.	1071 (liquid) & 1071A (liquid)	Manual or automatic; no leach	More than 100 hours	USA 57-0-2C Type I QQZ-325 Type II QQP-416 Type II	Hardware, ordnance & communication items.
	Jet Black, glossy or matte finish, maximum corrosion protection.	1060, 1060A, & 1061 (liquids)	Manual or automatic; no leach	More than 100 hours	USA 57-0-2C Type I	Zippers, hardware, toys, communications.
Zinc Die Castings	Iridescent yellow finish, maximum economy, maximum corrosion protection, excellent paint base.	95 (liquid) or 1081 (solid)	Manual or automatic; no leach	More than 100 hours	QQZ-325 Type II QQP-416 Type II	Fuel pumps, carburetors, housings, hardware.
	Dark, iridescent yellow finish, maximum corrosion protection.	1071 (liquid) & 1071A (liquid)	Manual or automatic; no leach	More than 100 hours	QQZ-325 Type II QQP-416 Type II	Fuel pumps, carburetors, housings, hardware.
	Dark brown finish, maximum corrosion protection.	1075 (liquid)	Manual or automatic; no leach	More than 100 hours	QQZ-325 Type II QQP-416 Type II	Fuel pumps, carburetors, housings, hardware.
	Black finish.	1060, 1060A, & 1062 (liquids)	Manual or automatic; no leach	More than 100 hours	None applicable	Zippers, toys, hardware.



This rubber-lined Fulflo Filter with 24 10-inch Honeycomb Filter Tubes, is installed on 1,000-gallon copper cyanide tank. At flow rate of 3000 gph, complete tank turnover is provided 3 times per hour.

Thousand-Gallon Tank *turned over 3 times per hour with* Fulflo Filters

High tank turnover with Fulflo Filters gives you a harder, firmer plate without costly rejects. You get these results with a small, compact filter that's low in price and requires practically no maintenance.

Tank turnover of 3 times per hour is equivalent to complete tank filtration four times in an eight-hour day. To achieve 5-micron clarity at this high flow rate ordinarily requires filters that are prohibitively large and costly (two or three times the size of Fulflo Filters — and two or three times as expensive).

Fulflo Filters are compact — take as little as 3 square feet of floor space. Low-cost Honeycomb Filter Tubes run for eight weeks or more without attention in the average shop — and are then easily replaced by unskilled labor. In addition, it's seldom necessary to clean the sides and bottom of the tank because of increased agitation and true *depth* filtration. Impurities are trapped in hundreds of diamond-shaped filtering tunnels *inside* the Honeycomb Filter Tubes.

For booklet on the "New Concept of Plating Filtration", write to Department PL.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

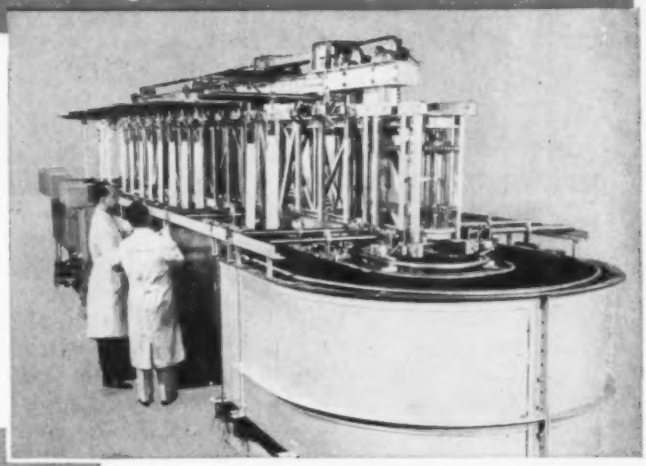
MICRO-CLARITY AT MINIMUM COST

Fulflo Filters — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

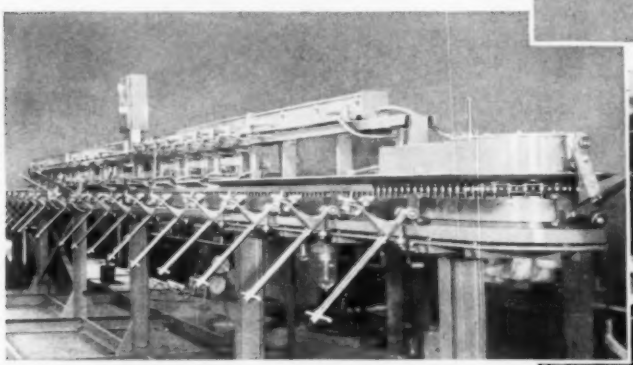
CFC Filters — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

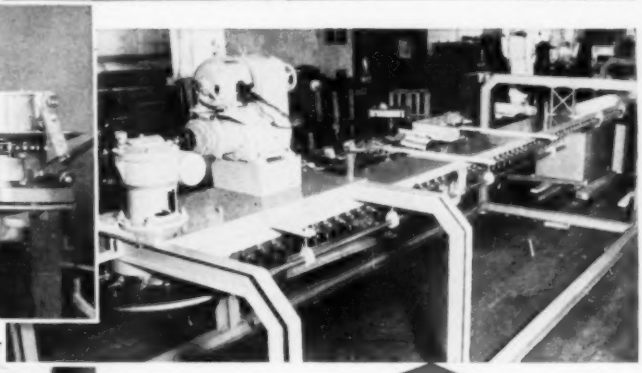
LASALCO has an automatic for any plating or anodizing operation!

CYCLEFLEX Full Automatic Plating & Anodizing Machine.
Most versatile of all automatics! No overhaul or rebuilding to switch cycles—just a simple moving in positions of pick-up heads and minor changes in tank partitions. Safety controls prevent conveyor breakdowns and load dropping. Many adaptations for any requirement. Low headroom.

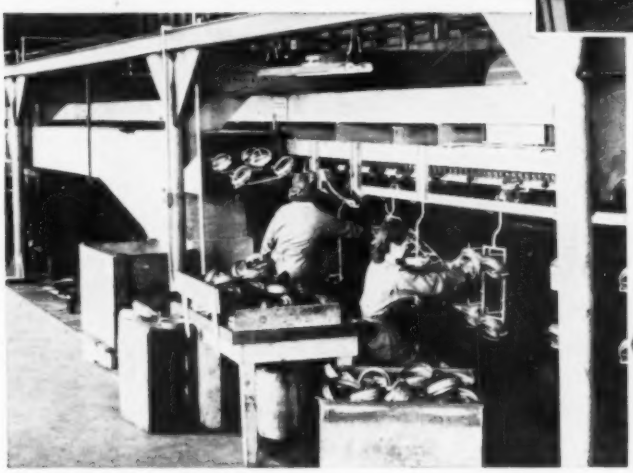


SELECT-O-MATIC Multiple Process Plater.
Handles 2, 3 or more process cycles at one time! While loading, operator merely turns dial to select desired cycle for individual racks and the rest is fully automatic! One operator can handle several different processes simultaneously. Saves investment in a variety of machines—reduces floor space requirements—cuts maintenance to a minimum.





DAW JUNIOR CONVEYOR
Fully automatic handling of individual parts. Tailor-made for any production output and any cycle. Tank to tank work transfers raise carriers to above horizontal to prevent solution carry-over, and eliminate air or gas pockets in work. Automatic unloading if work permits.



DAW SENIOR CONVEYOR
Custom-engineered, fully automatic, for any job, any cycle, any production requirement. Transfers from one tank to another raises work from vertical to above horizontal to facilitate drainage, prevent solution dragout. Handles racks for all sizes and quantities of parts. Automatic unloading unless shape or work size is too large.

Write For Descriptive Literature

Lasalco has the sound experience and proved ability to analyze your exact needs, and to give you equipment that will increase output do it better, faster, and far more profitably. Phone or write for the services of a Lasalco engineer.

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Everything for Plating and Polishing

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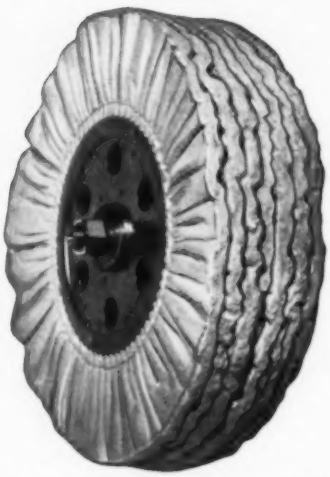
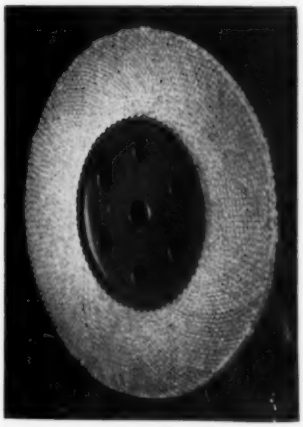
(cloth or Sisal)
for polishing
and/or buffing
parts having contoured
surfaces

Longer life—
More parts buffed with
less compound
Fully ventilated and
cooler operating
Pre-tested, accurately
balanced & ready faced
For added safety—one
row of extra heavy
concentric sewing close
to center plate





KUL-KUT Sisal Buff
for cut and color
in one operation
on plain or
stainless
steel

A complete line of air-cooled bias type buffs for every need
Additional information and prices will be supplied on request—a trial will
prove conclusively that KUL-KUT BUFFS are the most economical to use

BUFFING COMPOUNDS EXTRUDED ANY SIZE TO FIT YOUR APPLICATION

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Complete Plating Plants Furnished

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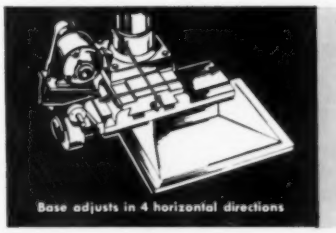
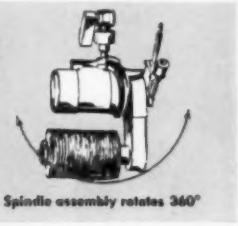
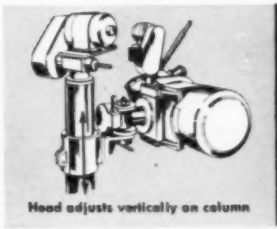
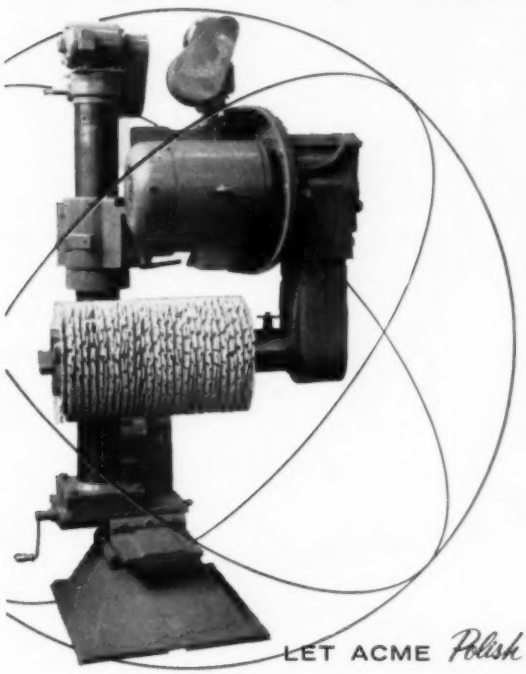
ACME G-4 KEEPS CONVERSION COSTS DOWN!


Base adjusts in 4 horizontal directions


Spindle assembly rotates 360°


Head adjusts vertically on column

Head feed is motorized



If you want machines that will set up for a fast, efficient finishing job on today's work—yet will quickly and easily adapt to next year's designs—ask an Acme engineer to show you the versatile G-4 lathe.

What does the G-4 do? Just about everything! Only four of its many adjustments are illustrated. Without the need for superstructure support, the buffing or polishing head may be faced in four directions horizontally and two vertically. It may be angled to any degree from horizontal to vertical. It may be stationary when it operates, or set for a stroking or oscillating movement. It finishes the most common or the most unusual shapes . . . reduces belt, buffing wheel and compound costs . . . and is ready for adaptation to new designs any time!

An Acme engineering specialist can help you combine these flexible basic units with automatic work-holders or fixtures to give you a set-up for low-cost, high-production finishing. Contact him to discuss your current or anticipated demands. No obligation, naturally.

LET ACME *Polish Off* YOUR FINISHING PROBLEMS

ACME MANUFACTURING COMPANY

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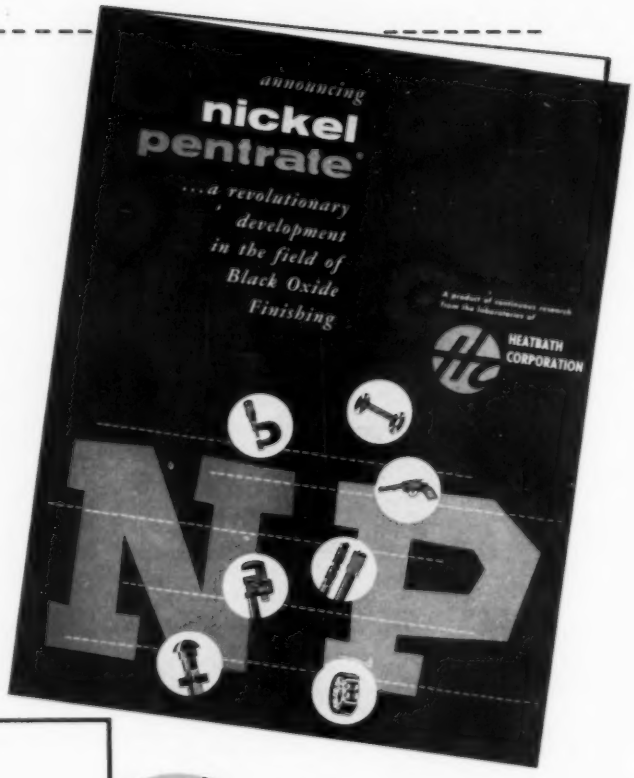
- Controls colloidial iron in bath
- Contains inhibitors, activators, rectifiers and surface active agents
- Simple and inexpensive to operate — one salt, one bath
- Durable finish — no dimensional change
- Exceeds requirements of military specifications

The Nickel Pentrate process and composition are fully covered by United States patents. Foreign patents applied for.



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36 years of Service to the Heat Treating and Metal Finishing Industry

Send now for descriptive literature giving the complete story of Nickel Pentrate and how it can help you in your business.

PENTRATE: Registered U. S. Pat. Off.

"WE LICKED OUR ANODIZING MIST AND SPRAY THE EASY WAY . . ."

ROBERT A. NYQUIST, CHIEF CHEMIST
THE ELECTRIC AUTO-LITE COMPANY
BAY MANUFACTURING DIVISION
BAY CITY, MICHIGAN

"In our aluminum anodizing operation, we were encountering excessive gassing from our 15-18% sulphuric acid solutions.* In addition, we were getting a severe sulphate build-up on our lead cathodes and copper bus which was hindering our current carrying capacities. We couldn't control this problem even with our push-pull ventilation, so we began looking about for an effective method of suppression. And we found it!

"With the addition of just *one pound* of Udylite 'Zero-Mist' per 1,000 gallons of anodizing solution, we now control sulphuric mist and hold the spray down to 2-3 inches from top of the solutions. This was checked by saturating filter papers with alkaline phenolpthalein solution and suspending the papers at various levels before and after the addition of 'Zero-Mist' (see inset). The addition of 'Zero-Mist' made necessary by dragout is easily determined by visual and nasal observations. This easily maintained additive is our simple solution to an otherwise difficult processing problem."

Using Udylite 'Zero-Mist' in the anodizing operations such as the Electric Auto-Lite installation, is just one more application for the versatile 'Zero-Mist' family. Let your local Udylite representative demonstrate the many time and money saving advantages of 'Zero-Mist' at your convenience. Call him now, or write direct to:

*Zero-Mist has proven satisfactory in Chromic acid solutions also.

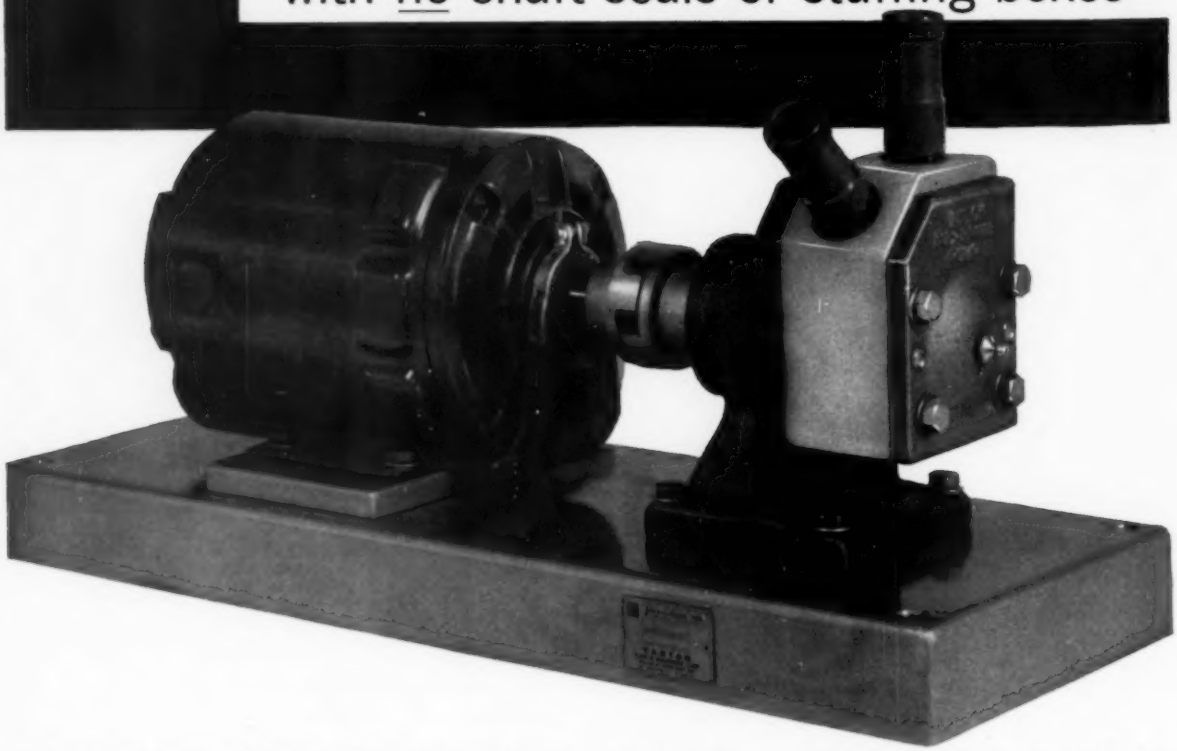
the udylite corporation

detroit 11, michigan • world's largest plating supplier

the VANTON Plastic "Flex-i-liner" pump

the only (repeat-ONLY) plastic rotary pump

with no shaft seals or stuffing boxes



The unique Vanton "flex-i-liner" design *eliminates stuffing boxes, shaft seals, gaskets and check valves*. Fluid contact is limited to the inner surface of a plastic housing and outer surface of a durable precision molded plastic or synthetic flexible liner. This allows safe and continuous handling of tough corrosives and abrasive slurries.

"Flex-i-liner" pumps are furnished in these materials:

Polyethylene—"P" Series—Excellent resistance to strong acids and alkalies. Excellent general chemical resistance and non-contaminating. Recommended for such typical applications as: Hydrochloric, Chromic, Hydrofluoric, Nitric, Phosphoric and Sulphuric acid: Calcium and Sodium Hydroxide; Sodium Hypochlorite; Hydrogen Peroxide and Distilled Water.

Buna N—"N" Series—High temperature resistance and suitable for use with weak acids, strong alkalies, vegetable and mineral oils. Recommended for such typical applications as: Plating Solutions, Chemical Salt Solutions at elevated temperatures; Petroleum Products; Tuna Fish Oil; Shortening; Ferric Chloride and Tile Glaze Slurry.

Bakelite—"B" Series—Excellent for organic solvents and organic acids. Good for weak acids and alkalies. Recommended for such typical applications as Acetic, Formic and Oleic acids; Ethyl and Methyl Alcohol; Carbon Tetrachloride; Gasoline, Kerosene, Fuel Oils; Photographic Solutions and Glycerine.

Liners are available from stock in Neoprene, Buna N, Gum or Natural Rubber, Hycar, Hypalon, Silicone, Vinyl or Compar.

Self priming with a gentle pumping action, Vanton plastic "flex-i-liner" pumps are available in capacities from ⅓ — 20 GPM and can be furnished direct connected to constant speed or variable speed motor equipment. Vacuums up to 26" Hg. are developed.

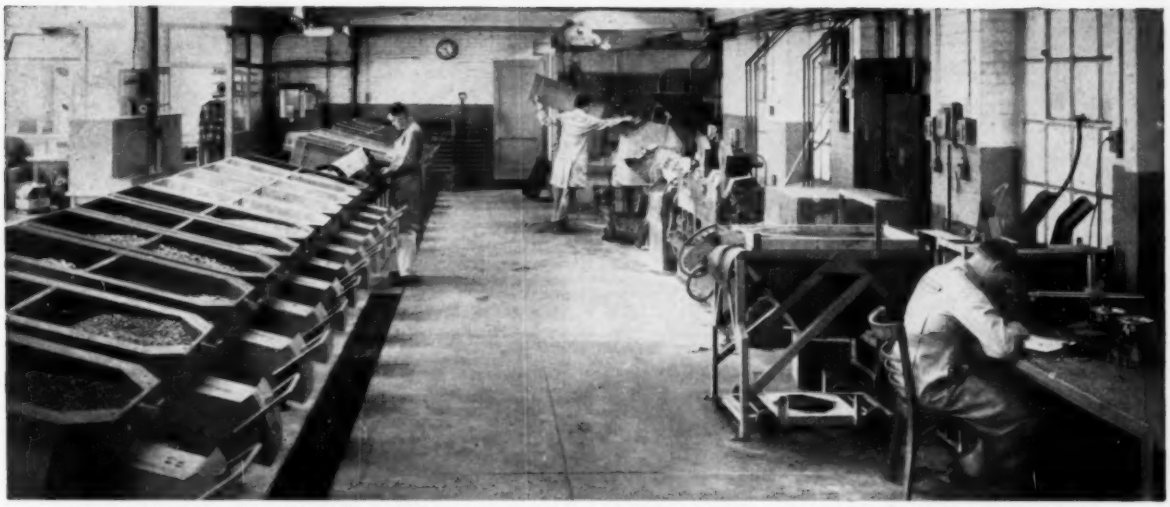
Bulletin VP562 on request.

VANTON

PUMP & EQUIPMENT CORP.

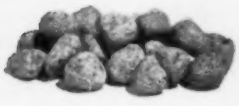
division of Cooper Alloy Corporation HILLSIDE, N.J.

Now's the time...here's the place



The big Norton Sample Processing Department solves your finishing problems with a wide variety of tumbling equipment . . . and the right abrasive to do the job.

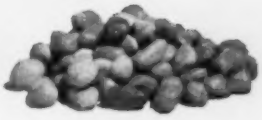
to find the tumbling abrasive you need



ALUNDUM® TUMBLEX® "A" Abrasive. For general barrel finishing. Removes flash, scale, tool marks and burrs, while forming radii and finishes to required micro-inches. Seventeen sizes.

ALUNDUM TUMBLEX "T" Abrasive. Bonded, triangular and fast-cutting for special shaped parts. They won't wedge in work slots or holes. Four sizes.

ALUNDUM TUMBLEX "S" Abrasive. Bonded spheres that get into areas where other shapes can't reach. Exceptionally dense and long lasting. Five sizes.



TUMBLEX "N" Abrasive. Natural stones, exclusively Norton. For high lustre, especially on die castings and soft metal. Rounded shape brings up highest lustre. Seven sizes.

G-341

If you're still finishing metal parts the long, hard way, now's the ideal time to find the fastest, most effective barrel finishing equipment, methods and abrasives.

For example, one leading aircraft parts manufacturer reports saving over $90,000 yearly by shifting from hand-finishing to barrel finishing with Norton TUMBLEX abrasives.

There's one sure way for you, too, to get these cost-cutting, product-improving "Touch of Gold" advantages. Your metal parts can range from tiny needles to hefty forgings . . . may be simple or complicated, hard metals or soft . . . may require deburring, descaling, better color and closer finish. Just send sample parts to our Sample Processing Department. They'll be returned to you completely finished to requirements, with a detailed report. Or, next time you're in our area, drop in and learn how your finishing can be improved.

NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors all around the world.

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NORTON

ABRASIVES

Making better products... to make your products better

NORTON PRODUCTS
Abrasives • Grinding Wheels • Grinding Machines
Refractories

BEHR-MANNING DIVISION
Coated Abrasives • Sharpening Stones
Pressure-Sensitive Tapes

INCREASE

20% OR MORE

YOUR ZINC PLATING PRODUCTION SPEED WITH PROMAT'S AMAZING GRAIN REFINING AGENT FOR ALKALINE ZINC SOLUTIONS

PROZN C-42

- ANTI-BURNING!
- INEXPENSIVE TO USE!
- IDEAL BASE FOR CHROMATES!
- HIGH CURRENT DENSITY GRAIN REFINER!
- DEPLETED ONLY BY DRAG-OUT!
- LOW CONCENTRATION!
- STABLE AT HIGH TEMPERATURES!
- TRIED AND TRUE—IN USE FOR 15 YEARS!
- MEETS MILITARY REQUIREMENTS!
- MOST IMITATED ADDITION AGENT ON THE MARKET!

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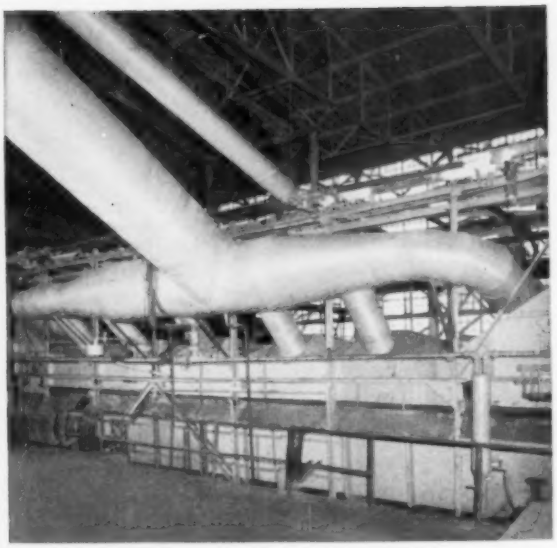
WAUKEGAN, ILLINOIS

Complete service and laboratory facilities at your disposal.

USE READER SERVICE CARD; INDICATE A 922.



AVAILABLE:

STANDARD* PLASTIC CORROSION PROOF COMPONENTS FOR ACID *FUME* REMOVAL!

You can easily install corrosive fume removal systems; using lightweight, easy-to-handle, standardized components of RIGIDON (fiber glass reinforced) and RIGIVIN (Vinyl P.V.C.) developed by Heil corrosion proof equipment experts. These standard components include: Hoods, Ducts, Stacks, Fittings, Tank Covers, Flat Sheets, and Cementing Kits. And HEIL will help you — write describing your fume problem, for recommendation of the type and size of plastic duct system to use.

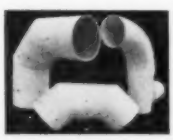
Ask us to send standard parts catalog sheets.

HEILASTIC LININGS — Rubber, Koroseal, Plastic.

METAL FABRICATION — Steel Plate, Sheet Metal, Lead, Alloys.

HEIL also produces: Tanks, Heaters, Heat Exchangers, Exhaust Systems, Lined and Solid Plastic Fans, Fume Scrubbers, Packed Towers.

***HEIL will also "custom-fabricate" a special fume removal system to your specifications, regardless of size.**



Light, strong elbows and fittings.

Units are easily assembled, using standard cementing kit.

Hoods furnished complete in standard sizes.

One source — One responsibility

CHEMICAL PROOF LININGS · TANKS HEATERS PLASTICS

HEIL PROCESS EQUIPMENT
CORPORATION

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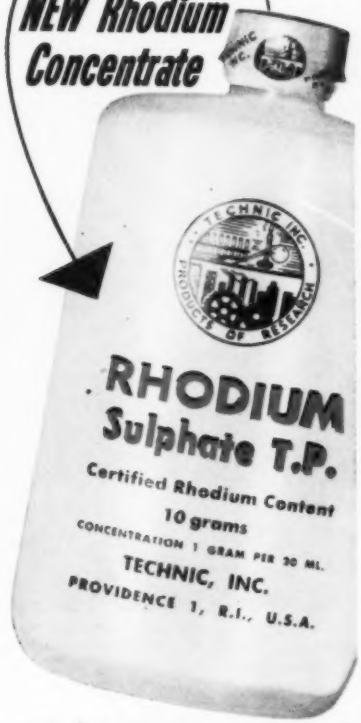
USE READER SERVICE CARD; INDICATE A 923.

Test this NEW Rhodium Concentrate



an improvement by **TECHNIC**

Technic developed this superior Rhodium concentrate to meet today's electroplating specifications with —

- ✻ Lower Stress
- ✻ Higher Purity
- ✻ Finer Grain

Testing is easy because of high compatibility with existing Rhodium baths. Ask for complete data on characteristics and applications. When you adopt Technic solutions or methods, our technical staff is yours until optimum performance is assured. Write or phone today.

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TECHNIC, INC
PRODUCTS OF RESEARCH

355-8

THE LARGEST ENTERPRISE OF ITS KIND IN THE WORLD

A low priced ...vacuum type filter

Designed for use as an individual filter for multiple tanks in large shops. Ideal as a quality, low cost filter for small plating shops.

Capacity 500 G.P.H.
Price $395.00
Model PV-20-1000 G.P.H.
Price $850.00

A new simplified construction principle makes this low price possible.

The Sparkler Plater's-Pal will handle acid and cyanide solutions (except chromic acid and high chloride nickel).

The Sparkler PLATER'S-PAL will filter

Arsenic Cyanide
Brass Cyanide
Bronze Cyanide
Cadmium Cyanide
Copper Cyanide
Neutralizers (Cyanide & Borax)
Tin Stannite
White Brass Alloy
Zinc Cyanide
Acid Copper Sulphate
Acid Zinc
Black Nickel Acid
Cadmium Fluoborate
Copper Fluoborate
Lead Sodium Fluoborate
Lead Sulfamate
Nickel
Palladium
Tin Fluoborate
Tin Nickel Alloys

Sparkler plating filters are used in some of the largest plating plants in the world.

SPARKLER
PLATER'S-PAL
FILTER

* Only clean solution flows through the pump—no excessive pump wear.
* Visual inspection of all parts including filter plates possible without dismantling filter.
* All solution reclaimed.
* Completely enclosed but with easy access to operating parts.
* Cover locks and unlocks with one quick opening connection—no cover bolts, no complicated sealing devices.
* Can be cleaned and back in operation in 10 minutes.
* Positive uniform quality of filtration at all times.

Sold only through plating suppliers

SPARKLER FILTERS

Sparkler Manufacturing Co.
Mundelein, Illinois
Sparkler International Ltd., with plants in Canada, Holland, Italy & Australia.
Filtration engineering and manufacturing exclusively for over 25 years.

DU PONT PRODUCT NEWS

REG. U. S. PAT. OFF.

QUESTIONS FROM THE FLOOR are answered during a Du Pont cost-analysis seminar by technical representatives George Hetrick and Dave Haring (left to right). Fred Low, technical service manager of Du Pont's Chlorine Products Division, stands by as moderator. Cost-analysis specialists are featured speakers at Du Pont Cost Seminars.

Unique Du Pont seminars point up advantages of cost analysis in metal cleaning

As an extra service for their customers, distributors of "Triclene" D trichlorethylene are scheduling seminars conducted by Du Pont metal-cleaning specialists. The purpose of these meetings is to give metal fabricators like yourself helpful information about modern metal-cleaning methods and a basis for comparing them.

High point of the seminars is a detailed discussion of Du Pont's new cost-analysis service. This is a method of accounting, based on accepted principles, that helps you determine the complete cost of your present cleaning operation . . . pinpoint out-of-line costs and show how they can be reduced. This new service can help you improve your current operation or help you select the most efficient process if you're planning to expand.

You can get full details about the seminars and cost-analysis service through your distributor of Du Pont "Triclene" D trichlorethylene. He works hand in hand with Du Pont technical representatives to bring you the best metal cleaning available at lowest possible cost. Get in touch with him today, or mail coupon at right.

Answers to questions most frequently asked at the Du Pont cost seminars:

Q. Your cost analysis sounds fine, but how am I going to get the basic information needed? I don't keep a fine breakdown of cleaning costs.

A. We have recently prepared information that will give you all the instructions you need for making a cost analysis. Included are data for obtaining estimates when you need them. Also, Du Pont technical men are always available to help you.

Q. Do all trichlorethylenes have the same effect on cleaning costs?

A. Not at all! "Triclene" D contains an *exclusive* combination of neutral stabilizers that virtually eliminates rejects and permits easier, less frequent degreaser cleanouts. Naturally, these factors have a definite influence on metal-cleaning costs.

Q. Why has Du Pont spent the time and money to establish this cost-analysis service?

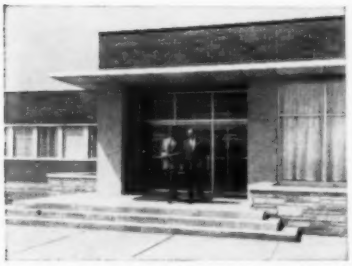
A. For two reasons. First, an accurate method for analyzing metal-cleaning costs has long been needed in this field. Du Pont, pioneer of vapor degreasing with synthetic solvents, is in the best position to offer this needed service. Second, we believe that in most cases we can prove to you that vapor degreasing is more economical than alkali washing for metal cleaning. If we can, and if you choose our "Triclene" D trichlorethylene, we *both* stand to profit.

Q. Anything new coming up in vapor degreasing?

A. Yes, indeed. A process now finding commercial acceptance combines degreasing and painting in the same degreaser. A further advance still in the development stage integrates phosphatizing between degreasing and painting.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 926.

FOR MODERN METAL CLEANING



New laboratory houses plant-scale equipment for demonstration and customer service.

New DuPont laboratory helps your distributor provide more service

A phone call to your "Triclene" D distributor will make available outstanding technical service from a Du Pont Solvents Technical Representative. Service that's yours without obligation. What's more, this service is now given extra support by the facilities provided at the new Du Pont Sales Technical Laboratory at Wilmington, Delaware.

Your Du Pont Solvents Technical Representative is up to date on the latest developments in the field. He works closely with your "Triclene" D distributor and together they can keep you posted, provide you with useful literature on improving your metal-cleaning operation. Remember, it's their job to keep your degreasing setup at peak efficiency.

Want more facts about vapor degreasing with "Triclene" D? Free booklet tells how vapor degreasing works, shows types of equipment, points out many cost-saving advantages. Just mail coupon for your copy

cut out and save

Use this handy check list for evaluation of metal-cleaning processes

You'll find the chart below helpful in selecting a metal-cleaning process for your new plant or to replace existing outworn equipment. Engineers who consider all of the factors listed frequently find that the speed, flexibility, quality and economy of vapor degreasing make it the best answer to their cleaning needs. Your local Du Pont Solvents Technical Representative will be glad to help you evaluate vapor degreasing in light of your requirements. You can arrange to have him call through your distributor of "Triclene" D trichlorethylene or through the local office of the Electrochemicals Department. Arrange for a call today!

	VAPOR DEGREASING	ALKALI WASHING	EMULSION CLEANING
SOILS—Can it readily remove?			
1. Stamping and machining oils	Yes	( )	( )
2. Most polishing and buffing compounds	Yes	( )	( )
3. Drawing compounds	Yes	( )	( )
4. Quenching oils	Yes	( )	( )
5. Water-emulsion cutting oils	Yes	( )	( )
6. Shop dirt	Yes	( )	( )
7. Paints	Many	( )	( )
METALS—Can it clean thoroughly without etching?			
1. Steel	Yes	( )	( )
2. Aluminum	Yes	( )	( )
3. Other nonferrous metals	Yes	( )	( )
4. Plastics	Many	( )	( )
OTHER MAJOR CONSIDERATIONS			
1. Fast cleaning action?	Yes	( )	( )
2. High capacity—low investment?	Yes	( )	( )
3. Good penetration into recesses?	Yes	( )	( )
4. Soil redeposition?	None	( )	( )
5. Foaming problems?	None	( )	( )
6. Do parts emerge dry?	Yes	( )	( )
7. Handle all shapes and sizes?	Yes	( )	( )
8. Waste-disposal problem?	None	( )	( )
9. Utility requirements?	Low	( )	( )

E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Department P-9, Wilmington 98, Delaware

☐ Please send me your booklet on vapor degreasing.
☐ Please send me more information on your new cost-analysis method.
☐ Please have your representative call for an appointment.

*Name*_____ *Position*_____

*Present method of cleaning*_____

*Firm*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

DU PONT
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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

BOOKS

Remittance must accompany all book orders placed with AES Headquarters.

Coated Abrasives—Modern Tool of Industry, Coated Abrasives Manufacturers' Institute. 452 pp., 6 x 9, 546 illustrations. Members $7.10; Non-members $8.50.

Prepared under the auspices of the Coated Abrasive Manufacturers' Institute, this newly-published book brings together authoritative information to aid in the selection and use of coated abrasives. The nature of various types of abrasives, their economic advantages, applications and efficient methods of use are comprehensively covered.

The book shows how abrasives are manufactured, and describes all factors of their effective use in the metalworking and other industries, in applications ranging from heavy material removal to fine polishing.

The book gives comprehensive coverage of many recent advances in the field, including new automatic machinery, applications such as strip scouring, pre-plate finishing, and contour finishing, and discusses such special topics as cutting oils, coolants, and lubricants specifically for use with coated abrasives.

Guide to Electrodeposited Coatings and Other Surface Treatments for Metals. by D. E. Couch and J. W. Hensely, U. S. Naval Ordnance Test Station. Sept. 1954. 29 pp. (Order PB 131496 directly from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., 75 cents.)

This information was collected and tabulated to give the engineer a quick, reliable guide to the properties and uses of electrodeposited metals and to other chemical and electrochemical treatments used in metal finishing. The report is a generalization of the field of electrodeposition and does not attempt to explain the details involved. Nevertheless, it will provide aid in rapid evaluation of electrodeposited metals and other surface treatments. Chapters are devoted to discussion of the field and definition of terms. Tables are included for characteristics of electrodeposits, electrodeposited coatings, special chemical and electrochemical processes, and special coloring processes for decorative and photographic purposes.

Descaling and Cleaning of Titanium and Titanium Alloys, by D. W. Stough and others, Titanium Metallurgical Laboratory, Battelle Memorial institute for Office of Assistant Secretary of Defense (R&D). Mar. 1958. 68 pp. (Order PB 121640 directly from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $1.75.)

Present commercial practices for scaling titanium and its alloys were surveyed. Acid pickle baths were found to be generally used to remove scales formed on titanium at temperatures up to about 1100F. Scales formed above 1100F need more drastic treatment for removal, such as the molten-salt treatment followed by acid pickling. Proprietary descaling methods are discussed. Descaling practices at the major producers of mill products are also reviewed.

Test Methods for Magnesium Surface Treatments, by F. W. Pfohl and H. T. Francis, Armour Research Foundation for Wright Air Development Center, U. S. Air Force, Nov. 1957. 62 pp. (Order PB 131600 directly from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $1.75.)

A promising method for determining the quality of surface treatments for magnesium alloys was developed after a study showed existing tests for corrosion-inhibiting power of coatings to be unsatisfactory. The new method was based on measurement of paint adherence after exposure to a corrosive environment. The technique involved the "Gauze-Peel Test," in which a gauze strip is embedded in the organic coating. After exposure to accelerated corrosion, the gauze is peeled from the surface. Both quantitative (peel strength) and qualitative (visual examination of the stripped area) evaluations can be made easily.

SUPERIOR SERVICE IN APPLICATION ...IN USE

... One of the advantages available with Unichrome Coating 218X

Applicators of Unichrome Coating 218X, located in every major area, all have what it takes to assure you *fast* service, *expert* job, *longer lasting* rack protection.

They're equipped for it ... through long metal-coating experience ... and with the right facilities. They get coatings to stick tight by using Unichrome Primer 219-PX. They build up the top coat with skill, using the coating with a 10-year proof of satisfactory service. They cure it perfectly, for maximum toughness and service life in all plating and cleaning cycles.

These specialists know that vinyl plastisol Coating 218X will never let them or their customers down. They know that *using the best quality at the outset saves platers most money in the long run.* Send for name of the one nearest you.

Are you using the rack coating that gives you ALL FIVE?

1. *Built-in cure indicator assures maximum performance*
2. *No contamination of plating baths*
3. *Ability to be rebaked for patching*
4. *Nationwide set-up of expert applicators*
5. *Highly qualified technical service.*

UNICHROME

First name in plastisols for all plating purposes ...

METAL & THERMIT CORPORATION

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GENERAL OFFICES: RAHWAY, NEW JERSEY
Pittsburgh • Atlanta • Detroit • E. Chicago • Los Angeles
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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 928.

Sel-Rex

Plating Progress

Sel-Rex

Published by SEL-REX CORPORATION

SEPTEMBER 1958 NUTLEY 10, NEW JERSEY No. 4

A view of the Sel-Rex refining facilities. Here a lab technician pours electrolytically refined precious metals salts, removed from evaporator to his right, into centrifuge.

Up To 75% More Return On Precious Metals Salvage From New Refining Facilities

Up to 75% greater dollar return from plated scrap or spent solutions of Gold, Rhodium, Platinum, Palladium and Silver, are being realized consistently through latest scientific techniques and modern equipment in the new Sel-Rex Precious Metals refining facilities. Part of the new 40,000 square foot Sel-Rex plant, the division utilizes Spectrophotometers, Tube Furnaces, Polaragraphic Instruments and Muffle Furnaces for cupellation assaying, to give precise analysis of salvaged materials.

Specially designed containers to facilitate shipment of precious metals scrap or spent plating solutions are supplied free of charge.

How precious metals scrap is salvaged can mean the difference of many dollars to you and your company. Don't let these extra dollars slip away, by putting up with outdated recovery methods. Write for your copy of SEL-REX PRECIOUS METALS REFINING SCHEDULES as a basis for comparison, Better yet, arrange to send a sampling of your material which we will assay — no obligation. We think you'll be pleasantly surprised.

Ask for #PMS for details.

FREE LITERATURE CORNER

Just Off The Press...

- ☐ PMS • Precious Metals Refining Schedules.
- ☐ PMF • Pre-Met Filter Product Bulletin.
- ☐ PPB-1 • Portable Plating Barrels Product Bulletin and price list.
- ☐ PLT-1 • Platanex—Reliable, low stress Platinum plating for high temperature and general industrial uses.
- ☐ RX-2 • Rhodium Electroplating Processes—24 pages, demonstrations and charts.

Still Available...

- ☐ PR-1 • Completely new "Guide" to Plating Rectifiers—20 pages illustrated.
- ☐ AG-2 • Acid Gold Process—developed for printed circuit plating—4 page technical report.
- ☐ BR-a • Gold Plating, Industrial & Decorative, by E. C. Rinker—8 pages, illustrated.

NOTE: For your convenience, when requesting the literature you want, simply refer to it by the prefixed code.

Sel-Rex Portable Plating Barrels Offer Premium Quality At Lowest Cost

Low cost Sel-Rex Plating Barrels offer such high cost features as: full ½" gauge high temperature Plexiglass used throughout; gears machine cut from ⅝" Plexiglass; scientifically spaced steel dangle contacts, or steel center rod contact—to give even contact coverage for superior plating results; stainless steel tie-rods and screws; totally enclosed motors, also encased in heavy gauge Plexiglass.

Sel-Rex Portable Plating Barrels are available in the following stock sizes: 6" x 10" and 6" x 12" with 1/50 H.P. motor; 8" x 18" with 1/20 H.P. motor. Larger or intermediate sizes and special attachments on special order.

For further details ask for product bulletin #PPB-1.

New Low Cost Portable Solution Filter Is Leak-Proof

A rotating magnetic field to drive the pump impeller eliminates the need for troublesome seals or stuffing boxes on the new Sel-Rex Pre-Met Filter. In addition to making the unit leak-proof —no more costly precious metals solution losses—this innovation also eliminates contamination by lubricants in pharmaceutical, biological or beverage processing.

The Pre-Met Filter uses a canned turbine pump-motor which is continuously lubricated by the solution. A stainless steel filter tube houses an element of specially processed cotton or dynel yarn wound around a stainless steel core. This cartridge provides "depth filtration" through interlaced layers totalling 500 square inches of area per cartridge. Filtration area may be increased inexpensively in multiples of 500 square inches by attaching additional filter tubes. The following maximum flow rates would apply: 1 tube—300 GPH, 2 tubes—500 GPH, 3 tubes—700 GPH, 4 tubes—800 GPH. Flow rates are easily adjusted from near zero to maximum by simple pinch valves, since the canned turbine pump-motor does not overload due to flow restriction, and will use less power as flow is diminished. Accordingly, considering the low price of the basic unit, it is entirely practical and economical

to install a Pre-Met Filter for applications requiring *flow rates as low as 25 GPH.*

Ask for #PMF for additional details and product bulletin.

Aluminum
anodizing, buffing and cleaning

No matter what your aluminum finishing problem or need, you'll find the answer at H-VW-M... because it is the one company combining a complete engineering service with a complete line of equipment and supplies!

ELECTRICAL EQUIPMENT — Want the best possible recommendation of a Rectifier . . . Generator . . . or Control Equipment for your particular operations? Page 2 tells how to get it.

STILL TANK OR FULL AUTOMATIC EQUIPMENT — Whatever your need — from a single component to a complete, integrated system — H-VW-M supplies it . . . Page 3.

ENGINEERING SERVICE AND INSTALLATION –H-VW-M engineers and technicians are anodizing equipment specialists, with years of experience. Page 3 tells why these H-VW-M services mean greater efficiency and savings in your plant.

ALUMINUM FINISHING SUPPLIES — Page 4 shows how H-VW-M research has resulted in new compounds, improved buffs and cleaners to make aluminum finishing easier, better.

HANSON-VAN WINKLE-MUNNING CO. · MATAWAN, NEW JERSEY, U.S.A.

HANSON-VAN WINKLE-MUNNING COMPANY
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These H-VW-M Anodizing and Finishing to New Savings, New Efficiency, New

ELECTRICAL EQUIPMENT

H-VW-M is the only manufacturer of both Germanium and Selenium Rectifiers *and* low voltage, direct current Motor Generator Sets for the metal finishing industry. This thorough experience in every phase of low voltage power generation and rectification means that when you bring your power problems to H-VW-M you're sure to get the perfect equipment recommendation.

Self-Contained Rectifier with Tap Switch Control

Remote Controlled Rectifier with Tap Switch Control

Germanium and Selenium Rectifiers . . . Rectifier Controls

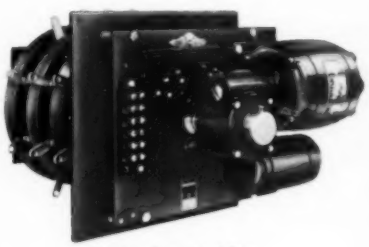
Highest quality and efficiency, flexibility, economy and low maintenance are the characteristics combined in H-VW-M's full line of both Germanium and Selenium Rectifiers. 6 to 48 volt units—both remote and self-contained—provide the exact direct current low-voltage and high amperage required in aluminum anodizing. The widest possible choice of controls and control combinations is available. Such devices as manual or motor operated tap switch controls, continuously variable auto-transformers and saturable core reactors are used with or without supplemental controls to provide automatic voltage stabilization, automatic constant current as well as automatic programming.

Write for Bulletin ER-108, which gives further information about Rectifiers and Controls, plus useful control application suggestions.

Manual Tap Switch Control

Saturable Core Reactor

Continuously Variable Auto-Transformer

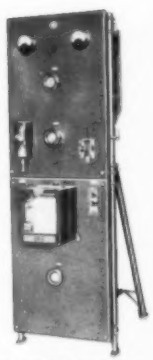


Motor Operated Tap Switch Control

Generators . . . and Controls

H-VW-M Motor Generators designed especially for metal finishing operations are built in sizes up to 50,000 amperes, and accessory equipment includes a full line of controls and control panels to cover any desired control function. Easy-to-maintain H-VW-M Motor Generators have exceptionally rugged and practical construction features insuring maximum performance and life. Standard voltage ratings range from 6 to 50 volts, and include the 18 and 24 volt units usually required for sulphuric acid anodizing, plus the 40 and 50 volt units used in chromic acid anodizing. Write today for 24-page Bulletin G-104, covering in detail all H-VW-M Generators.

15,000 Ampere, 6-Volt Generator Unit

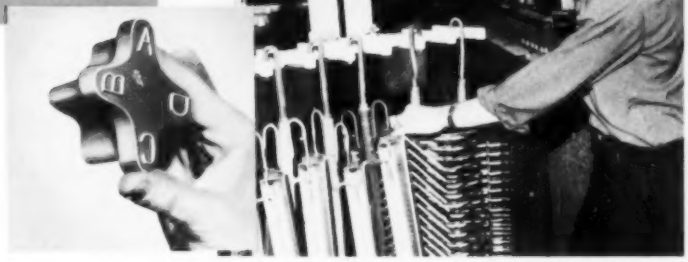


Automatic Anodizing Control Panel

Supplies, Equipment and Services Add Up Simplicity of Operation in Your Plant

PROCESSING EQUIPMENT

Whatever your anodizing procedure, there's an H-VW-M Full Automatic Conveyor that can be adapted to any production application requiring automatic cycling of individual treatments—or an H-VW-M Tank with accessory equipment that is perfectly adapted to still tank methods of any kind.



Automation in Metalfinishing— *Full Automatic Conveyors with Dial-A-Cycle*

Workman "dials" desired cycle in refrigerator plant. Parts will by-pass or lower into baths as dial setting dictates.

H-VW-M's new DIAL-A-CYCLE system automates nine or more complete metalfinishing processes on a single anodizing or electroplating machine. This revolutionary by-pass mechanism can be used on any metalfinishing installation for anodizing, electroplating, or similar processing. It is especially useful and effects substantial cost reductions when a variety of parts requires several different processes or colors.

DIAL-A-CYCLE, as the name implies, is controlled by a simple dial setting. The dial is mounted on the carrier arm that carries the parts through processing tanks. It is set by the machine operator for the processing steps through which each load of unfinished parts is to move. Automatic conveying then takes over, lowering the parts into the required tanks and bypassing others.

Different products, requiring different anodizing cycles, may be processed at the same time, with the same equipment. DIAL-A-CYCLE gives you new versatility while reducing operating, labor, and maintenance costs. Close, automatic control of transfer and immersion periods improves quality.

DIAL-A-CYCLE is the newest of many types of conveyors and equipment H-VW-M supplies to aluminum finishers. H-VW-M also designs, manufactures, and installs return-type conveyors . . . elevator conveyors . . . straight-line conveyors . . . and others. For a complete description of all types, write for Bulletin FA-105.

Tanks and Equipment

At H-VW-M—the plating and anodizing industry's workshop—you'll find tank equipment for every phase of your work. For chromic acid anodizing, H-VW-M double electric welded unlined steel tanks are offered, along with steel coil equipment for cooling and heating. The entire system is H-VW-M designed, supplied and installed. For sulphuric acid anodizing, lead-lined steel tanks, plus the necessary cooling coils and air agitation assembly, are supplied. Tanks are fabricated from hot rolled steel, stainless steel, and aluminum. Other types of tanks are also available. Bulletin No. T-108 gives full particulars about this important H-VW-M equipment. Every conceivable type of auxiliary equipment is engineered and supplied, according to customers specifications, including a complete packaged refrigeration system for anodizing solutions.

And H-VW-M's Engineering and Installation Service

Anodizing problems of *any* kind? H-VW-M is prepared to set up your entire anodizing system from beginning to end—a system made up of components scientifically engineered to work together with utmost efficiency. Because of this, and because of H-VW-M's continuing research and development in every aspect of the anodizing picture, you can be confident that the recommendation you receive from H-VW-M is the very *best*.

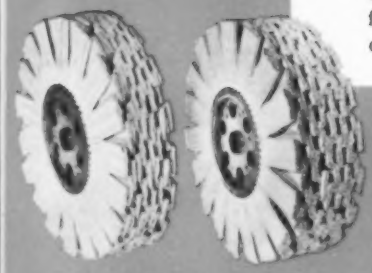
What's more, if requested, H-VW-M sees to it that the equipment you buy is H-VW-M *installed*. This means perfect, efficient operation from the start.

Add to this the fact that an H-VW-M technical representative—ready to serve you—is no further than your telephone. These representatives serve in principal cities across the nation. Get to know the one nearest you. He can help you get the most from your aluminum finishing equipment and supplies.

TURN THE PAGE FOR ALUMINUM BUFFING AND CLEANING SUPPLIES

ALUMINUM BUFFING AND CLEANING SUPPLIES

Since aluminum came into its own after World War II, considerable H-VW-M research and development work has been devoted to the perfection of buffs and compounds suiting the unique physical characteristics of this popular light metal. When long-wearing H-VW-M Buffs are used in conjunction with H-VW-M compounds especially formulated for aluminum finishing, you have the perfectly balanced combination for economy, efficiency and quality performance.



Buffs

Nowhere will you find a wider selection of the buffs you need for preanodizing operations than at H-VW-M. Whether you're looking for a super-heavy-duty buff like new steel-centered Ruff-L-Buffs (which are available untreated, or Binderized® for extra long wear) medium duty buffs like Triplex Buffs, or a buff for medium-to-light service such as the Full Disc Buff, you need look no further than H-VW-M. The full H-VW-M line also includes new Tufta-Flex Buffs (cloth tufts) and Sisal-Flex Buffs (with sisal-centered tufts).

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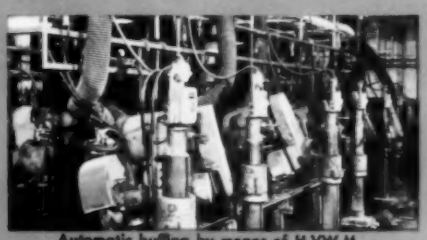

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THE CHEMISTRY OF WATTS NICKEL PLATING SOLUTIONS

by EDWARD B. SAUBESTRE*

ABSTRACT

The chemistry of the Watts nickel bath is taken up in terms of each of its major constituents. Nickel sulfate is shown to determine the cathode reduction conditions for nickel plating. The deposition potential of nickel is determined from the standard potential, as corrected for the activity of the nickel ion in a sulfate bath, and the activation overvoltage of nickel. Factors which make the deposition of nickel irreversible are considered. The role of nickel chloride is considered in terms of anode dissolution, and high speed deposition at the cathode. It is shown why nickel chloride plays little role in nickel plating at most current densities in the Watts bath. Oxidation reactions occurring at the anode are also discussed. The role of boric acid as a buffer, and complexing agent is discussed in terms of the various polymers which form in solution from boric acid. The chemistry of various types of anti-pitting agents used here and in Europe is considered. Some experimental data are given on all-sulfate baths, operated in plating solutions containing ion-exchange membranes.

THE CHEMISTRY OF WATTS NICKEL plating solutions will be considered in terms of each of the principal constituents found in such baths. The following formula has been arbitrarily chosen for purposes of performing calculations, and is not necessarily recommended as the preferred one for any particular application:

$NiSO_4 \cdot 6H_2O$	330 g/l
$NiCl_2 \cdot 6H_2O$	60 g/l
H_3BO_3	30 g/l
*p*H	2;5
Temperature (°C)	50
Current density (asf)	50

I. NICKEL SULFATE—$NiSO_4 \cdot 6H_2O$

The principal ingredient of a nickel plating solution is nickel sulfate, $NiSO_4 \cdot 6H_2O$. Its function is to supply the required nickel ion for electroplating. It is suitable for this use because it provides nickel ion in an uncomplexed form, (though ion association does occur to a significant degree, as will be discussed later) has a high degree of solubility, is a relatively inexpensive nickel salt, and is readily available commercially. In earlier days, nickel ammonium sulfate, $NiSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ (nickel double salt) was used as the source of nickel for the bath. However, its solubility is limited, being about 102 g/l at room temperature, and about 175 g/l at 50 C. By comparison, solubility of nickel sulfate is about 460 g/l at room temperature, and 570 g/l at 50C.

Since the nickel sulfate content essentially establishes conditions for nickel plating, the deposition potential of nickel from sulfate solutions will be next considered.

A. Standard Electrode Potential of Nickel

An examination of the standard electrode potentials would indicate that at unit activity, discharge of hydrogen would be favored over nickel deposition:

(1) $Ni(H_2O)_4^{++} = Ni + 4H_2O - 2e$ $\quad E^\circ = -0.25$

(2) $2H(H_2O)^+ = H_2 + H_2O - 2e$ $\quad E^\circ = 0.00$

Yet, it is obvious from common knowledge that nickel is deposited at high current efficiencies. The explanation lies in the correction factors which must be applied to the standard potentials to correspond to conditions in Watts nickel plating solutions. The two main corrections to be applied are for the activity of the ions and for the activation overvoltage. Each of these will be considered in turn.

B. Activity of the Nickel Ion

The activity of the nickel ion is a measure of the effective concentration of the ion at the cathode interface. For standard electrode potentials, the activity of the reacting ion is assumed to be one, i.e., equivalent to 1 mole/liter of effective ion concentration at the cathode. For a practical nickel plating solution, the activity of the nickel ion is dependent on the concentration of nickel salt in the plating solution, its degree of dissociation, the activity coefficient of the nickel ion, and the total concentration of other electrolytes. The activity coefficient is a measure of the extent to which interionic attractions in concentrated solutions reduce the effective concentration of the free ion. The application of these quantities will be illustrated for nickel sulfate solutions. Since, in a Watts bath, nickel sulfate is the predominant electrolyte, the effect of the presence of other dissociated salts will be neglected.

It was first formulated by Bjerrum[1] and later amplified by Fuoss and Kraus,[2] that when a compound such as nickel sulfate dissolves in a concentrated solution, some of it remains undissociated, while, of the part that does dissociate, a large amount consists of ions which associate because of

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TABLE I

Structure of Nickel Atoms and Ions

I. Ni^{++}—simple nickel ion

	3d					4s	4p		
	·	·	·						
$1s^2 2s^2 2p^6 3s^2 3p^6$	·	·	·	·	·				

II. $Ni(H_2O)_4^{++}$—tetraquo nickel ion

	3d					4s	4p		
	·	·	·			x	x	x	x
$1s^2 2s^2 2p^6 3s^2 3p^6$	·	·	·	·	·	x	x	x	x

Hybridization—sp^3

III. $Ni(H_2O)_3^{++}$—activated nickel complex ion

	3d					4s	4p		
	·	·	·			x	x	x	
$1s^2 2s^2 2p^6 3s^2 3p^6$	·	·	·	·	·	x	x	x	

Hybridization—sp^2

IV. Ni—metal in lattice

	·	·	x	x	x	x	x	x	
$1s^2 2s^2 2p^6 3s^2 3p^6$	·	·	·	·	·	·	·	·	

Hybridization—d^2sp^2

In the above diagrams, · refers to electrons from the nickel atom, and x refers to electrons from donors which lead to the indicated hybridized orbitals. Two electrons can exist in every orbital, since, by the Pauli exclusion principle, they may be distinguished by opposite spins.

the electrostatic (Coulombic force) attraction between the oppositely charged ions:

(3) $NiSO_4 \cdot 6H_2O$ (cryst.) = $NiSO_4$ (aq) = $(Ni^{++}SO_4^{=})^0$ (aq.) = $Ni(H_2O)_4^{++} + SO_4(H_2O)^{=}$

In addition to the ion pair $(Ni^{++}SO_4^{=})^0$, further association may occur with the free ions to produce triplets and quadrupoles:

(4) $(Ni^{++}SO_4^{=})^0$ (aq.) + $Ni(H_2O)_4^{++}$ = $(Ni^{++}SO_4^{=}Ni^{++})^{++}$ (aq.)

(5) $(Ni^{++}SO_4^{=})^0$ (aq.) + $SO_4(H_2O)^{=}$ = $(Ni^{++}SO_4^{=}SO_4^{=})^{=}$ (aq.)

(6) $2(Ni^{++}SO_4^{=})^0$ (aq.) = $\begin{bmatrix} Ni^{++}SO_4^{=} \\ SO_4^{=}Ni^{++} \end{bmatrix}^0$ (aq.)

In solvents of high dielectric constant such as water, these ion pairs and the like are much affected by the solvent molecules, and it is perhaps more accurate to refer to dissociated, but electrochemically "unfree" ions as being more loosely associated with a "cloud" of oppositely charged ions:

$$\begin{matrix} & SO_4^{=} & \\ SO_4^{=} & Ni^{++} & SO_4^{=} \\ & SO_4^{=} & \end{matrix}$$

rather than as present in the form of more tightly associated ion pairs, triplets, or quadrupoles.

Thus, in making calculations on the reduction of nickel ion at the cathode in electroplating, it is necessary to know first the degree of dissociation of nickel sulfate, and second, of the total amount of ions dissociated, it is necessary to know what fraction of the ions are "free," as opposed to those which are associated in one form or other, with ions of opposite charge.

Let K = the dissociation constant for nickel sulfate, m = molarity of the compound in solution, α = the degree of dissociation of nickel sulfate into its ions, whether "free" or in ion pairs, γ the activity coefficient of the undissociated salt, γ^+ and γ^- the activity coefficient of the ions, and $\gamma_\pm$ the mean activity coefficient of the salt. Then, from equation (3) above, we obtain, in terms of the activity (a) of the ions:

(7) $$K = \frac{(a_{Ni^{++}})\,\alpha\,(a_{SO_4^{=}})\,\alpha}{(a_{NiSO_4})\,(1-\alpha)} = \frac{(\gamma^+ m\,\alpha)\,(\gamma^- m\,\alpha)}{(1-\alpha)\,m\,\gamma}$$

It will be assumed that the activity coefficient of undissociated nickel sulfate is unity (probably a valid assumption), and that the individual ionic activity coefficients, γ^+ and γ^- are equal (probably valid, since both nickel and sulfate ions are divalent, and according to Kielland[3] have about the same effective diameter of the hydrated ion. According to the Debye-Huckel theory, at least in dilute solutions, the valence and the diameter of the hydrated ion determine the individual activity coefficients). Since the mean activity coefficient, $\gamma_\pm = (\gamma^+\gamma^-)^{1/2}$, then, $\gamma_\pm = \gamma^+ = \gamma^-$.

From the plating solution formula given previously, m = 1.33, and according to Money and Davis,[4] K = 0.0040 at 25C, and according to Harned and Owen,[5] $\gamma \pm$ = 0.0382 at 25C. Substituting these values in equation (7) and assuming the simplifications given above, it is found that the degree of dissociation, α = 73.4 per cent, and that the activity of the "free" nickel and sulfate ions is 0.037. Summarizing, in a Watts nickel plating solution, the following happens when 350 g/l of nickel sulfate is dissolved in water:

$$\begin{array}{lcccccc} (8)\quad NiSO_4{\cdot}6H_2O\ (cryst) & \rightarrow & NiSO_4\ (aq) & = & (Ni^{++}SO_4^{--})^0 & = \\ 1.33 & \rightarrow & 0.35 & + & 0.94 & + \\ & & Ni(H_2O)_4^{++} & + & SO_4(H_2O)^{--} & \\ & & 0.037 & + & 0.037 & \end{array}$$

Having determined the activity of the nickel ion, the electrode potential may be calculated by using the Nernst equation, in which E is the electrode potential as corrected for ion activity, E^0 is the standard electrode potential, R is the gas constant, T is the absolute temperature, z is the valence change in the reaction, and F is the Faraday constant:*

$$\begin{aligned} (9)\quad E &= E^0 + (RT/zF) \log a_{Ni^{++}} \\ &= -0.25 + 0.064/2 \log 0.037 \\ &= -0.30 \text{ v} \end{aligned}$$

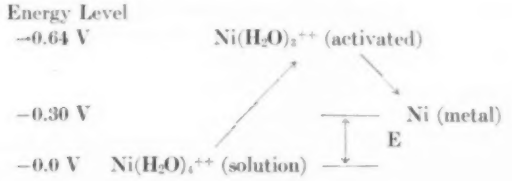
C. Activation Overvoltage of Nickel

The activation overvoltage for a cathode reaction is a measure of the fact that in going from the ionic to the metallic form of the element, an intermediate, high energy step is involved. The amount of this intermediate energy determines whether the reaction is reversible or irreversible. It has been found that for nickel, the activation overvoltage is quite high, i.e., the deposition of nickel is very irreversible in nickel plating solutions.

Why is this so? For an answer, the structure of nickel in the ionic and metallic forms must be considered. In a nickel sulfate solution, nickel exists in two forms:

$$Ni(H_2O)_6^{++} \text{ and } Ni(H_2O)_4^{++}$$

It will be noted that a considerable amount of water is associated with the nickel ion in solution; this is called the water of coordination, and the resulting ion is called an aquo complex. In the bulk of the nickel plating solution, the $Ni(H_2O)_6^{++}$ ion predominates, but plating probably takes place largely from the $Ni(H_2O)_4^{++}$ form. Since conversion of one form to the other occurs rapidly, only the $Ni(H_2O)_4^{++}$ ion need be considered. According to Lyons,[6] the activated complex consists of one less coordination bond, i.e., nickel in the activated form is largely $Ni(H_2O)_3^{++}$. Pictorially:**



* Throughout this paper, RT/F is calculated at 50 C, viz., 0.064.

** The voltages shown are for the particular conditions described in the text.

The structure of the nickel ion in solution and in the activated form will now be compared with the structure of nickel metal. The electrons which surround the nucleus of an atom do not exist in random orbits, but in families of orbits, called shells. In each shell, there are several groups of orbits, called the s, p, d orbitals. In the case of the nickel ion, the first two shells are complete, and do not take part in reactions. In the third shell, the s and p orbitals are filled, and likewise, do not take part in reactions. However, the 3d orbitals are not filled, and they and the 4s, and 4p orbitals take part in chemical reactions at the cathode.

In the diagrams of Table I, all orbits below the 3d level are ignored, since they do not take part in reactions. In a given orbital, an electron may either be paired with another electron, or it may exist in an unpaired form. In the case of nickel ion, there are several unpaired electrons in the 3d orbital (see Table I). As pointed out above, in solution, nickel ion exists in the form of a hexaquo complex, but this form rapidly converts to the tetraquo complex from which plating actually occurs (see Table I). In the activated form, this is further reduced to three waters of coordination. When this ion is discharged to nickel metal, it gives way to a nickel atom which is surrounded by six other nickel atoms in the lattice. Table I shows the structural difference between nickel metal and nickel ions. It will be noted that nickel metal and nickel ion differ in that two electrons from the fourth shell must be transferred somehow into the third shell. This requires considerable energy, and accounts for the irreversibility of nickel deposition. Further details on the irreversibility of deposition of transition metals, such as nickel, and on electronic structure, will be found in Lyons,[6] Piontelli,[7] and Pauling.[8]

The value of the activation overvoltage of nickel may be calculated by knowing the constants required for the Tafel equation, which defines the overvoltage as a function of cathode current density. The Tafel equation is (assuming that the transfer coefficient = 0.5):

$$(10)\quad \eta_a = RT/F \log i/i_o$$

where η_a is the activation overvoltage, i is the current density of deposition, and i_o is the exchange current. The exchange current is the current which passes in either direction between an electrode and a solution of its ions under reversible conditions. When electronic rearrangements are required, as shown in Table I for nickel, the value of the exchange current is small, and the value of the activation overvoltage is correspondingly large. Using a value of 10^{-13} g-ions/cm^2-sec for the exchange current for nickel at 20C,[9] and assuming a decrease in overvoltage of 2.5 mv/°C, the activation overvoltage of nickel at 50C and 50 asf becomes −0.34 v.

The above discussion implies that the activation step is the limiting one which accounts for the irreversibility of nickel deposition. Although the theory presented, based largely on work by Lyons, accounts for many observed facts in plating a variety of metals, it is speculative in that convincing experimental evidence for the proposed mechanism is lacking as yet. The role of concentration polarization is being neglected in this discussion, but theoretical work by Conway and Bockris would indicate that in nickel deposition, ion diffusion (transfer across the double layer) is the rate limiting step. This is probably true at higher current densities, and indirect experimental evidence for this will be presented below in discussion of the relationship between current density and current efficiency, and in discussion of the effect of the chloride

ion at the cathode. However, the analysis given above is felt to be very useful in explaining the difference in irreversibility between nickel and (for example) copper plating. It can also explain the difference in exchange currents noted by Bockris between nickel and copper discharge.

D. Activity and Overvoltage of Hydrogen

Regarding activity of the hydrogen ion, we will assume that in the high *p*H nickel bath, the *p*H in the cathode film rises to no higher than 6, since at values much above this level, nickel hydroxide would precipitate, and the deposit would be burnt. (This is based on a value of the solubility product of $Ni(OH)_2$ of 1.6×10^{-16}. If $a_{Ni^{++}} = 0.037$, then $(Ni^{++})\ (OH^-)^2 = 1.6 \times 10^{-16}$, or, $OH^- = 6.6 \times 10^{-8}$, leading to a *p*H value of 6.1). In the low *p*H bath, we will assume that for a bulk *p*H of 2, the cathode *p*H rises to 3. This gives a hydrogen ion activity at the cathode of 10^{-6} and 10^{-3} for the two cases. Using the Nernst equation as before, the relevant deposition potentials for hydrogen evolution become -0.38 v and -0.19 v respectively.

The overvoltage of hydrogen on nickel may be determined from the Tafel equation, preferably written in the following form:

$$(11) \quad \eta_a = a + b \log i$$

If the current density, i, is expressed in amp/cm², then, at 20C, a = 0.67 and b = 0.116 [10]. Assuming a decrease of 2.5 mv/°C, then at 50C and 50 asf, the overvoltage of hydrogen is 0.42 v.

E. Deposition of Nickel vs. Hydrogen

From the above data, the deposition potential of nickel may be calculated from the standard electrode potential as follows:

$$(12) \quad \begin{aligned} E &= E^0 + \text{activity correction} - \text{overvoltage} \\ &= E^0 + (RT/zF) \log a_{Ni^{++}} - RT/F \log i/i_o \\ &= -0.25 - .05 - 0.34 = -0.64 \text{ v} \end{aligned}$$

The corresponding values for hydrogen are:

$$(13) \quad E = E^0 + (RT/zF) \log a_{H^+} - a - b \log i$$

Low *p*H bath: $= 0.00 - 0.19 - 0.42 = -0.61$ v

High *p*H bath: $= 0.00 - 0.38 - 0.42 = -0.80$ v

Comparing the values of nickel and hydrogen:

Nickel	$E = -0.64$ v
Hydrogen (low *p*H)	$E = -0.61$ v
(high *p*H)	$E = -0.80$ v

Thus, efficiency of nickel deposition from a sulfate bath should be high in the high *p*H bath, but will be lower in the low *p*H bath.

The effect of increasing current density from zero to about 20 asf is to increase nickel deposition efficiency. This arises from the fact that the activity of the nickel ion at the cathode is 0.037, while that of the hydrogen is 10^{-6} to 10^{-3}. Thus, depletion of the cathode film in hydrogen is more marked than depletion in nickel. In effect, at very low current densities, hydrogen is being "dummied" from the bath. Temperature has only a minor effect on current efficiency, but agitation may be deleterious to a slight extent, since it will replenish the depleted hydrogen ion content in the cathode film. At higher current densities, the nickel deposition efficiency decreases with increasing current density. This is because, at high current densities, the diffusion of nickel ions to the cathode becomes the controlling step and the transport number of hydrogen is much greater than that of nickel.

II. NICKEL CHLORIDE—$NiCl_2.6H_2O$

A. Chloro-complexes

Strangely enough, in view of its technical importance, very little is known about the manner in which nickel deposits or dissolves in a plating solution containing chlorides. By analogy with its group members, palladium and platinum, and with its neighboring atom, cobalt, it might be expected to form the complex ion $NiCl_4^=$. Barvinok[11] has studied a similar complex for cobalt and finds it to be very stable only in strong HCl solutions. Bailar[12] concludes that the chloronickel complex is not easily characterized. Nickel, unlike any other metal of Group VIII B, does not show any adsorption by anionic exchange resins from hydrochloric acid solutions.[26] Since nickel ion can exist as $Ni(H_2O)_4^{++}$, it is possible that in Watts nickel plating solutions, the chloride ion complex may exist in some intermediate form, such as $NiCl(H_2O)_3^+$, $NiCl_2(H_2O)_2$, or $NiCl_3(H_2O)^-$. Certainly such complexes would account for the fact that nickel chloride is required for good anode corrosion. This can be seen readily by analogy with palladium and platinum:[13,14]:

$$(14) \quad Pt = Pt^{++} + 2e \qquad E^0 = -1.2$$

$$(15) \quad Pt + 4Cl^- = PtCl_4^= + 2e \qquad E^0 = -0.73$$

$$(16) \quad Pd = Pd^{++} + 2e \qquad E^0 = -0.99$$

$$(17) \quad Pd + 4Cl^- = PdCl_4^= + 2e \qquad E^0 = -0.62$$

Thus E^0 is less negative for the chloro complex than for the aquocomplex, i.e., the anode will dissolve easier in a chloride bath than in a sulfate bath.

B. Chloride in Nickel Deposition

We have previously considered nickel deposition solely in terms of nickel sulfate solutions. The effect of nickel chloride on conditions at the cathode will now be examined. By the same token as above, it might be expected that it would be less easy to deposit metal at the cathode from chloro complexes than from aquo complexes. In view of the meager information about nickel chloro complexes, however, it would be well to calculate the activity of the nickel ion in a chloride solution assuming that only an aquo complex forms. Let us consider a 0.25 M $NiCl_2$ solution, which is the concentration of nickel chloride in a Watts bath. The mean activity coefficient of nickel chloride in such a solution is[5] 0.47. Because of the difference in valence and diameter of the hydrated ion, the individual activity coefficients of nickel and chloride are not equal. In order to estimate the activity coefficient of nickel ion the following procedure is employed:

The activity coefficients of potassium ion and chloride ion are about the same in a potassium chloride electrolyte. A 0.25 M $NiCl_2$ solution has an ionic strength of 0.75, which corresponds to a 0.75 M KCl solution. For such a solution, the mean activity coefficient is[5] 0.62 which is also the activity coefficient of the chloride ion. Thus, the activity coefficient of nickel may be calculated from the following equation:

$$\gamma_\pm = 0.47 = (\gamma_+ \gamma_-^2)^{1/3} = (\gamma_+ 0.62^2)^{1/3}$$

$$\gamma_+ = 0.27$$

This procedure is an approximation only, since, at these concentrations, the activity coefficient of an ion is not exactly the same in different solutions of the same ionic strength. The activity of the nickel ion is then $\gamma_{\pm}m$, assuming complete dissociation, or, $0.27 \times 0.25 = 0.068$. (Complete dissociation is assumed, since the degree of dissociation of 2–1 salts is much higher than that of 2–2 salts.) The next question is what happens when nickel sulfate and nickel chloride solutions are mixed together, as in a Watts bath. In such cases, the mean activity coefficients tend to approach one another. Since the mean activity coefficient of nickel chloride is larger than that for nickel sulfate, this means that the mean activity coefficient of nickel chloride would decrease, and that of nickel sulfate would increase. There are insufficient data available to make meaningful calculations of this interaction, but probably no large error would result by assuming that the net activity of the nickel ion would be the sum of the values given above for nickel sulfate and nickel chloride solutions separately. Thus,

$$a_{Ni^{++}} = a_{Ni^{++}}\text{(sulfate)} + a_{Ni^{++}}\text{(chloride)} = 0.037 + 0.068 = 0.105$$

If this value is now used in equations (9) and (12), the deposition potential for nickel becomes 0.014 v. more positive than previously indicated. Thus, the conclusions arrived at in the previous section regarding nickel deposition in the absence of chloride are not changed. (This assumes that no change in activation polarization occurs. If, however, deposition of nickel from a sulfate solution occurs from an aquo complex, and deposition from a chloride solution from a chloro-complex, the activation polarizations might differ. However, magnetic measurements suggest that both Ni $(H_2O)_4^{++}$ and $NiCl_4^{=}$ possess sp^3 hybridization.[27] Thus, the activation polarizations should be similar.)

The question remains as to the role played by chloride at the cathode. The activity values given above are for the extreme case of simple additivity of the activities. At the other extreme, it may be assumed that all of the nickel chloride content is present in the form of a nickel complex. The above analysis indicates that at low current densities, deposition occurs under about the same conditions in both sulfate-chloride baths and all-sulfate baths. Some experimental conditions are given in Appendix 2, which lend support to the contention that at current densities below 100 asf, the chloride ion does not greatly affect plating conditions.

In an all-chloride bath, containing 1¼ M of nickel chloride, the activity of the nickel ion may be calculated by methods similar to those above, and will then be found to be 0.870. On this basis, the activity correction for the standard potential is negligible, and the deposition potential for nickel becomes $E = 0.25 - .34 = -0.59$ v. (assuming the same activation overvoltage) or about 0.05 v. larger than in the Watts bath. Data by Wesley and Roehl[25] indicate the actual difference to be about 0.1 v. This may indicate that the activation overvoltage of the chloro-complex is less than that of the aquo complex.

In any event, whether or not the chloride ion plays any important role in deposition at low current densities, there is no doubt of its importance in improving cathode efficiency at high current densities; more exactly, chloride in the bath increases the limiting current density above which burning occurs at the cathode.

The explanation for this lies in the relative diffusivities of nickel sulfate and nickel chloride. The limiting current density for metal deposition depends on the rate at which metal ions diffuse to the cathode. Specifically,

$$(18) \qquad i_l = \frac{D_+ ZFa_+}{(1 - n_+)\,\delta}$$

Where D_+ is the diffusion coefficient of the nickel ion, a_+ is its activity in the bulk of the electrolyte, n_+ is its transport number, and δ is the thickness of the diffusion layer, which depends upon the degree of agitation in large measure. Wesley et al[15] determined some values for the above equation which are valid for practical nickel plating solutions. The important difference, for our application is that the value of D_+ in a sulfate electrolyte is 1.04×10^{-5} cm²/sec at 70C, and 2.18×10^{-5} cm²/sec in a chloride electrolyte. Thus, other factors being equal, the limiting current density at the cathode in a chloride electrolyte is about twice that in a sulfate electrolyte. Specifically, Wesley calculated that the limiting current density in a still bath would be 135 asf in a 2.6 M $NiSO_4$ solution, and 280 asf in a 2.6 M $NiCl_2$ solution. This difference is due largely to the difference in diffusivities and not to differences in activity of the nickel ion.

C. Anodic Oxidation

Thus, the two main functions of the chloride content of the bath are to improve anode dissolution, and increase the limiting current at the cathode. In bright Watts baths, especially of the leveling variety, the chloride content must have a relatively high value. On the other hand, too high a chloride content in the bath can be deleterious in that the chloride ion can be oxidized at the anode. The discharge of nascent chlorine could serve to chlorinate organic brighteners, especially those which are unsaturated (see the next paper in this series).

In order to determine the chlorine discharge potential it is necessary to know the standard electrode potential, then to correct it for the activity of the chloride ion and for its overvoltage. The latter two properties are not well defined. The activity coefficient of the chloride ion was estimated previously as 0.62. The basis of calculation was that a 0.25 M $NiCl_2$ solution, which has an ionic strength of 0.75, would have the same chloride ion activity as a 0.75 M KCl solution, which has the same ionic strength. Since, in the latter compound, the individual activity coefficients are about equal, the mean activity coefficient of the compound is also the activity coefficient of the chloride ion. Thus, the activity of the chloride ion in a Watts bath is $a_{Cl^-} = \gamma^- m = 0.62 \times 0.5 = 0.31$.

Similarly, the overvoltage for chlorine discharge cannot be readily determined. However, its value is probably small. From data by Knobel,[16] it is probably 0.02 – 0.04 v. at 25C, and at 50C, it is probably a negligible correction.

Thus, the discharge potential for chlorine is:

$$(19) \qquad 2Cl^- = Cl_2 + 2e \qquad E^0 = -1.36$$

$$(20) \qquad E = E^0 + \text{activity correction} - \text{overvoltage} = E^0 + (RT/zF) \log (a_{Cl^-})^2 - 0.0 = -1.36 - 0.03 - 0.0 = -1.39 \text{ v}$$

The competing anode reaction when the anode is not dissolving is oxygen evolution. The *p*H of the anode film will be assumed to be 6, making the activity of the hydrogen ion 10^{-6}. The overvoltage for oxygen discharge is about 0.70 v. at 25C (averaged values from Latimer, Knobel[16], and Potter[10]). If overvoltage decreases 2.5 mv/°C, the value

becomes about 0.64 v. Thus, the discharge potential for oxygen is:

(21) $6H_2O = O_2 + 4H(H_2O)^+ + 4e \qquad E^0 = -1.23$

(22) $E = E^0 + \text{activity correction} - \text{overvoltage}$
$= E^0 - (RT/zF) \log (a_{H^+})^4 - 0.64$
$= -1.23 + 0.38 - 0.64 = -1.49$ v.

Comparing chlorine and oxygen discharge:

Chlorine: $E = -1.39$ v.

Oxygen: $E = -1.49$ v.

Thus, the reactions are about equally likely to occur. The chlorine discharge is somewhat academic, since in solutions of the concentration and *p*H of a Watts bath, the discharge of the chloride ion at an insoluble anode leads to reaction of the nascent chlorine with water, and also to its further oxidation, to produce, in either case, hypochlorite, chlorite, and even chlorate. In addition, as will be pointed out in the next paper dealing with bright baths, the nascent chlorine can react with the brighteners.

III. BORIC ACID—H_3BO_3

A. Buffering Action*

Boric acid is added to the nickel plating solution primarily to act as a buffering agent, to maintain the *p*H at the desired level. This buffering action arises from the fact that boric acid is but slightly ionized in aqueous solutions. The ionization constant for boric acid is:

(23) $H_2BO_3 + H_2O = H_2BO_3^- + H(H_2O)^+ \quad K = 6 \times 10^{-10}$

In strong boric acid solutions (0.5 M or more), boric acid tends to polymerize. The following free energies are taken or calculated from data given by Latimer and by Kolthoff:[17]

Substance	F^0 (kcal)
H_3BO_3 (aq)	−230.24
$H_2BO_3^-$ (aq)	−217.6
$H_2B_4O_7$ (aq)	−663.4
$HB_4O_7^-$ (aq)	−627.9

From this information, the following equilibria are given:

(24) $4H_3BO_3 = H_2B_4O_7 + 5H_2O \qquad K = 9.7 \times 10^{-4}$

(25) $H_2B_4O_7 + H_2O = H(H_2O)^+ + HB_4O_7^- \quad K = 10^{-4}$

(25a) $4H_3BO_3 = H(H_2O)^+ + HB_4O_7^- + 4H_2O$
$K = 9.7 \times 10^{-8}$

Also from the above information, it follows that in a Watts solution containing 0.5 M H_3BO_3, the equilibrium values of activity of the various constituents are:

Boric acid	H_3BO_3	0.499
Tetraboric acid	$H_2B_4O_7$	0.00006
Tetraborate ion	$HB_4O_7^-$	0.000078

This means, in practical terms, that the *p*H is 4.1, and that in boric acid solutions of this concentration, the bulk of the acidity comes from the tetraborate rather than from the (ortho) borate. This may be seen by inspecting equations (23) and, (25) from which it is obvious that tetraboric acid is a stronger acid than (ortho) boric acid. It should be pointed out that recent evidence indicates that in acid solutions, tetraboric acid probably does not exist as such,[18] but probably represents an equilibrium mixture of various polymeric borates.

The value of 4.1 given for the *p*H of a boric acid solution is also affected by temperature and the presence of free anions of strong acids. In a Watts solution, the temperature is about 50C, compared to the 20C for which the above equilibria are given. The sulfate ion in the Watts bath is present largely in associated form, as shown above, but the free chloride activity was shown above to be about 0.3. For (ortho) boric acid, Owen[19] and Owen and King[20] offer the following ionization constants:

	No chloride present	$a_{Cl} = 0.3$
20C	5.3×10^{-10}	1.15×10^{-9}
50C	8.5×10^{-10}	1.90×10^{-9}

Thus, at 50C and 0.3 of chloride content, the ionization constant is about three times as large as at 20C in the absence of chloride. Assuming, arbitrarily, that the same is true of tetraboric acid, the *p*H of the bath becomes 3.9.

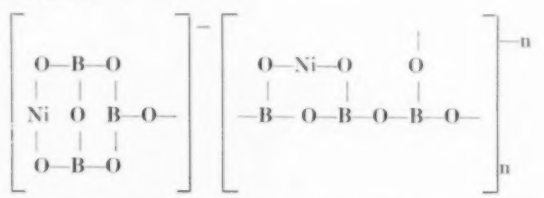
Boric acid, however, is used not only at a *p*H of about 4, but is used successfully in nickel plating solutions whose *p*H is 5. This may be because the boric acid complexes nickel, so that it does not buffer at *p*H = 4. This is explained below. Boric acid is also used in low *p*H Watts solution whose *p*H is about 2. In such cases, the boric acts as an effective buffer only in the cathode film, where the *p*H is higher than in the bulk of the electrolyte.

B. Borate complexes

Regarding the possibility of complex ion formation between boric acid and nickel, not very much is known presently about the structure of nickel borates. When (ortho) boric acid dissolves in water, the resulting anion is found to be thermodynamically indistinguishable from the (meta) borate ion:

(26) $H_3BO_3 + H_2O = H_2BO_3^- + H(H_2O)^+ = BO_2^- + H_2O + H(H_2O)^+$

When solutions containing nickel salts and boric acid are evaporated to dryness, only nickel (meta) borates are found. The simplest formula would be $Ni(BO_2)_2.2H_2O$. However, the (meta) borate ion tends to polymerize in solution, to form both cyclic trimers (boroxin rings), and linear polymers. Thus, nickel could conceivably form complex anionic structures, such as the following, illustrating both a cyclic and a linear polymer:



Note that in both cases, the nickel would be part of a six-membered ring type of chelate structure.

It is also claimed that boric acid produces whiter, finer-grained deposits, and helps to minimize formation of cracked, pitted deposits. However, these effects are probably related

*Correctly, buffering refers to the ability of a compound to prevent substantial *p*H changes in a given electrolyte. In nickel plating, we are concerned only with increases in *p*H in the cathode film (which could cause burning of the deposit through precipitation of nickel hydroxide). Thus, in referring to the buffering power of boric acid, we are considering only the ability to prevent an increase in *p*H, i.e., alkaline buffering.

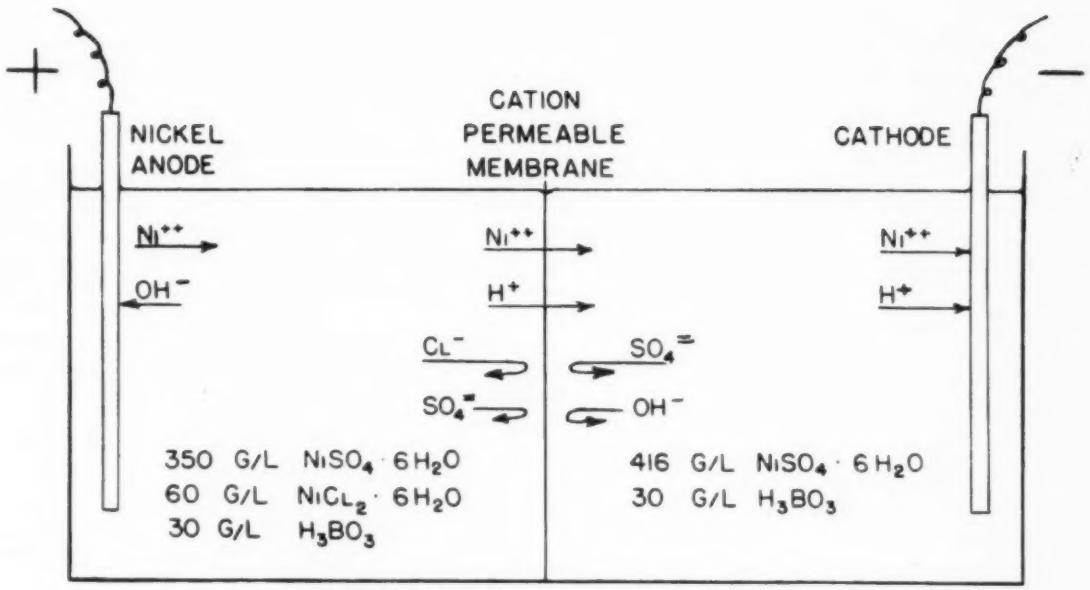


Fig. 1. Cell for soluble nickel anodes in all-sulfate baths.

to the buffering power and complexing action of boric acid, since Hammond showed many years ago[21] that boric acid could be successfully replaced by acetic, lactic, phosphoric, oxalic, tartaric, citric, succinic, and other acids. When nickel is complexed by such acids, its effective concentration is lowered, leading to greater concentration over-voltages. This effect in turn reduces the work of nucleation, so that the grain size of the deposit is greatly decreased.

IV. OTHER BUFFERS

As implied above, it should be possible to successfully formulate Watts nickel baths with acids other than boric as a buffer. However, few of these have found much commercial application. Boric acid as shown above, is satisfactory at a *p*H of 4. For low *p*H baths, other buffers might be more suitable, and at least two have found limited commercial use, acetic acid and formic acid. The dissociation constants, and the *p*H of 0.5 M solutions of the respective acids are:

(27) $CH_3COOH + H_2O = CH_3COO^- + H(H_2O)^+$
$K = 1.8 \times 10^{-5}$ $pH = 2.5$

(28) $HCOOH + H_2O = HCOO^- + H(H_2O)^+$
$K = 2.1 \times 10^{-4}$ $pH = 2.0$

V. ANTI-PITTING AGENTS

From the discussion given above, it appears that nickel is almost never deposited at 100 per cent cathode efficiency. Thus, some hydrogen discharge will occur at the cathode. As bubbles of hydrogen gas develop, prior to detachment from the surface, a region is formed in which no nickel plating will occur. Thus, formation of a pit takes place. There are three ways of minimizing pit formation. One method is to interrupt the nickel plating, as by transferring to another type of plating solution, changing plating parameters, PR, buffing, etc. A second method is to add an oxidizing agent that will prevent hydrogen formation. Among such agents are hydrogen peroxide, peroxysulfates, peroxyborates, and nitrates. The third method is to add a surface active agent that will lower the interfacial tension between hydrogen and the cathode surface, thereby encouraging detachment of the bubble.

A. Hydrogen Peroxide

Among the oxidizing agents, hydrogen peroxide is most commonly employed. It prevents hydrogen bubbles from forming in the following manner:

(29) $H_2O_2 + 2H(H_2O)^+ + 2e = 4H_2O$ $E^0 = +1.77$

Thus, it may be seen that addition of peroxide should be able to prevent hydrogen gas discharge. The above potential data are from Latimer. More recent work by Bockris and Oldfield[28] suggests a lower value of potential, 0.84. These authors found the potential to be independent of H_2O_2 concentration (above 10^{-6} M) and oxygen pressure, but to be dependent on *p*H in the following manner:

(30) $$E = 0.84 - \frac{RT}{F} pH$$

They ascribe these data to a first step in which H_2O_2 decomposes to adsorbed OH radicals, the latter then reducing to hydroxide:

(31) H_2O_2 (aq.) $= 2$ OH (ads.)
2OH (ads.) $+ 2e = 2$ OH^-

Thus, as long as the surface is completely covered with adsorbed OH radicals, the potential is independent of H_2O_2 concentration. Incidentally, the calculations of these authors suggest a standard potential of 0.96 − 1.02, which is not fully in agreement with their experimental value of 0.84.

Using the experimental data of Bockris and Oldfield, at *p*H = 2, the potential is 0.72 and at *p*H = 5, it is 0.54. Since the presence of peroxide should not only prevent hydrogen discharge, but also not prevent nickel discharge either, the potential should not exceed −0.64 v, the value previously given for nickel discharge. Thus, the peroxide content should not

exceed 10^{-42} at pH = 2, or 10^{-37} at pH = 5, in order to keep the discharge potential no higher than −0.64 v.

However, much more than this amount must be added, since hydrogen peroxide is quite unstable in water. It may decompose in a variety of ways. For example, according to Latimer:

(32) $2H_2O_2\,(aq.) = 2H_2O + O_2 \qquad K = 8 \times 10^{36}$

While not confirming the above equilibrium value, Azzam et al[29] suggest that this decomposition may account for the manner in which peroxide prevents hydrogen evolution:

(32) $2H_2O_2\,(aq.) = 2H_2O + O_2$

(33) $O_2 + H(H_2O)^+ + e = HO_2 + H_2O$

(34) $HO_2 + H(H_2O)^+ + e = H_2O_2\,(aq.) + H_2O$

(29) $H_2O_2(aq.) + 2H(H_2O)^+ + 2e = 4\,H_2O$

Note that the summation of the above reactions is identical with eq. (29). In practical terms, it has been found that stability decreases with increasing temperature and pH, and that periodic addition of about 1 part of 30 per cent H_2O_2 solution to 2000 parts of Watts plating solution will suppress pitting.

B. Peroxysulfates

It has been reported, particularly in French literature, that peroxysulfates repress pitting. This is probably due not so much to the peroxysulfate ion per se, but to its tendency to decompose to Caro's acid and thence to sulfuric acid and hydrogen peroxide:

(35) $S_2O_8^= + 4H_2O = (SO_5^=) + SO_4\,(H_2O)^= + 2H(H_2O)^+$

$(SO_5^=) + 2H_2O = SO_4\,(H_2O)^= + H_2O_2(aq.)$

$S_2O_8^= + 6H_2O = 2H(H_2O)^+ + 2SO_4(H_2O)^= + H_2O_2(aq.)$

$K = 7.6 \times 10^7;\ E^0 = +0.233$

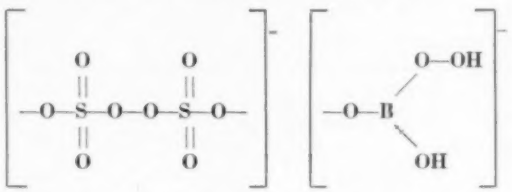
The peroxide thus produced would act as described above in Section V A. Even in the absence of oxidizing agents, such as peroxide or peroxysulfate, it has been observed that an aged nickel bath pits less than a new one. This has been attributed to oxidation of sulfate at the anode to peroxysulfate:

(36) $2SO_4(H_2O)^= - 2e = S_2O_8^= + 2H_2O \qquad E^0 = -2.0$

It was previously shown that, at an insoluble anode (for example, a polarized nickel anode which is not dissolving), the discharge potentials for chloride ion and hydroxyl ion are −1.39 v and −1.49 v respectively. Thus, the discharge potential for oxidation of the sulfate ion can be no more negative than about −1.4 v. Assuming no activation overvoltage, and a sulfate activity of 0.037 as before, the maximum permissible amount of peroxysulfate formation can be calculated to be $a_{S_2O_8^=} = 2.7 \times 10^{-22}$. Thus, anodic oxidation of the sulfate ion does not seem to be a significant factor in anti-pitting action of the bath.

C. Peroxyborates; Nitrates

Hydrogen peroxide and peroxysulfates are the two most widely used oxidizing agents. However, some others have seen commercial use, notably in France. Among these are peroxyborates and nitrates. At first, it might be thought that peroxyborates might be similar to peroxysulfates in effectiveness, since both contain the peroxy-linkage:



However, peroxyborate is a very unstable ion in water, and in aqueous solutions, exists almost entirely as boric acid and hydrogen peroxide:

(37) $H_2BO_4^- + H(H_2O)^+ = HBO_2{\cdot}H_2O + H_2O = H_3BO_3 + H_2O_2$

In view of the fact that Watts baths already contain boric acid, the addition of peroxyborates to the bath appears to be economically and technically unjustifiable compared to the addition of hydrogen peroxide.

Nitric acid is effective in a manner similar to hydrogen peroxide, in that it is a sufficiently strong oxidizing agent to prevent hydrogen gas discharge at the cathode. According to Latimer, the net reaction in dilute nitric acid solution is:
(38) $NO_3^- + 4H(H_2O)^+ + 3e = NO + 6H_2O \quad E^0 = +0.96$
Vetter (30) prefers the following:

(38a) $3H(H_2O)^+ + NO_3^- + 2e = HNO_2 + 4H_2O$
$E^0 = +0.94$

However, the reaction in the cathode film is quite slow if the nitric acid is dilute, and of necessity this is the case, since addition of more than 0.1–0.2 g/l of nitric acid to the bath tends to lower the current density at which burning of the deposit occurs. This occurs because hydrogen ion is consumed rapidly (see eq. 38; 38a), thereby raising the pH in the cathode film, and favoring burning of the deposit.

D. Wetting Agents

Use of oxidizing agents to reduce pitting is unsatisfactory in bright nickel plating solutions, since such oxidizing agents would not only prevent hydrogen discharge as desired, but would also oxidize the organic addition agents employed for brightening. Therefore, in bright nickel baths, it is practically necessary to employ surface active agents for this purpose. Such materials are often used in conventional dull Watts baths as well.

The surface tension of the solution, which is about 78 dynes/cm in the absence of wetting agents, should be lowered to at least 50 dynes/cm, and preferably to 30 dynes/cm by the wetting agents. A simple wetting agent for this purpose is sodium lauryl alcohol sulfate, at a concentration of 0.2–1 g/l. However, in proprietary baths for bright nickel plating, many types of anionic agents are used which are specifically compounded for use with the brighteners employed. In such cases, manufacturers' instructions should be followed with regard to choice of wetting agent.

Recent work indicates that wetting agents also improve uniformity of the deposit and improve the covering power of

the bath, as well as reducing the brittleness of the deposit, especially in leveling baths. According to Langford,[22] wetting agents also enhance leveling and decreases hardness of the deposit.

APPENDIX

1. Activity of Water

In the calculations made in this paper, the activity of water has been assumed to be unity, and has, therefore, been disregarded. In concentrated solutions, it must be realized that just as the solvent affects the activity of the solute, so the solute affects the activity of the solvent.

It can be shown that the influence of the solute on the solvent is much less than the converse. Specifically,

$$(39) \quad N_1 \, d \log a_1 = -N_2 \, d \log a_2$$

where N_1 is the mole fraction of the solvent, and N_2 is the mole fraction of the solute, a_1 is the activity of the solvent, and a_2 is the activity of the solute. Thus, since N_1 is much larger than N_2, deviations of a_1 from unity are much smaller than deviations of a_2 from unity as the concentration of the solute increases in the solution. As a result, the direct measurement of a_1 is not easily made. To obtain a more sensitive measure of the effect of the solute upon the solvent, Bjerrum[25] devised the concept of the osmotic coefficient. The "practical" osmotic coefficient is related to the activity of the solvent as follows:

$$(40) \quad \ln a_1 = -\Phi \Sigma m_i M_1/1000,$$

where Φ is the osmotic coefficient, and Σm_i is the sum of the molalities of all the solute ions and molecules present. M_1 is the molecular weight of the solvent.

For a binary solute such as nickel sulfate, assuming complete dissociation,

$$(41) \quad \ln a_1 = -\Phi (2m/55.5)$$

where m is the molality of the nickel sulfate. If dissociation is not complete, the values obtained by the above equation will err in the direction of being slightly too low.

If a Watts nickel plating solution contains 350 g/l $NiSO_4 \cdot 6H_2O$, the molality is about $1\frac{1}{3}$. From density data for nickel sulfate solutions, a liter of such a solution contains 991 g. of water. Of this amount, some is required to complex the ions. Since, in the bulk of the electrolyte, each mole of nickel ion requires six moles of water, and each mole of sulfate ion requires one mole of water, the total amount of water complexed with the nickel sulfate is 7(1.33), or 9.3 M, which is equal to 167.6 g of water. Thus, the amount of free solvent is 823 g water per liter of solution. Thus, the true molality of nickel sulfate is 1.62.

For this concentration of nickel sulfate, Robinson and Jones[24] give the osmotic coefficient as 0.521. Substituting in equation (41),

$$(42) \quad \ln a_1 = -0.521 \times 2 \times 1.62/55.5$$
$$a_1 = 0.971$$

No data are available on osmotic coefficients for the other constituents of the Watts bath. However, since nickel sulfate is the principal constituent, the activity of water will probably not decrease much lower than the value given above, perhaps no further than 0.94. Thus, for purposes of most of the calculations made in this paper, no serious error is introduced by assuming the activity of water to be unity.

2. Plating from All-sulfate Baths

In an effort to further define the role of the chloride ion at the cathode, an all-sulfate nickel bath was prepared, and compared to a Watts-type solution. The solutions employed were:

	Sulfate-Chloride	Sulfate
$NiSO_4.6H_2O$	350 g/l	416 g/l
$NiCl_2.6H_2O$	60 g/l	—
H_3BO_3	30 g/l	30 g/l
Temp. (C)	51	51
*p*H (color.)	3.8	3.8
Ni (as metal)	92.8 g/l	92.8 g/l
Impurity analysis:		
Chloride	—	0.012 g/l
Cobalt	0.46 g/l	0.16 g/l
Iron	0.028 g/l	0.046 g/l
Copper	0.007 g/l	0.010 g/l
Zinc	0.014 g/l	0.020 g/l
Manganese	0.48 g/l	0.55 g/l
Magnesium	0.19 g/l	0.26 g/l
Aluminum	0.018 g/l	0.014 g/l

Current efficiencies were obtained on deposits prepared in a constant current density box. A stirrer was employed to provide agitation. The following cathode current efficiencies were obtained:

Current density (asf)	Sulfate
5	99.6
20	98.6
30	98.6
40	101.0
60	89.9
80	88.7
100	82.2

Deposits from the Watts bath were obtained at about 97 per cent efficiency. All deposits were of acceptable quality, except that deposits from the all-sulfate bath become quite stressed above 60 asf. All deposits were matte white up to 60 asf. Above 60 asf, deposits from the Watts bath were still matte white, but those from the all-sulfate bath were nearly bright. The bright deposits were brittle and highly stressed.

Thus, it is concluded from the above that the chloride ion plays little role in determining the electrochemical conditions for discharge of the nickel ion at the cathode at current densities up to about 60 asf. At higher current densities the chloride ion has some effect, probably due to the diffusivity effects discussed in the text. At all current densities, of course, the chloride ion plays an important role in anode dissolution (anodes in the all-sulfate bath are passive) and in increasing the conductivity of the bath.

These results do not quite check those obtained some years ago by Wesley and Roehl.[25] They found that increasing chloride content of the bath tended to increase the cathode current efficiency slightly, even at low current densities. They also found that increasing chloride content decreased the cathode potential nearly 0.1 v., which is not in accord with the analysis presented in this paper, which would imply a smaller effect. However, comparisons with the work of Wesley and Roehl are not easily made, since, in studying various nickel baths, they varied more than the sulfate-

chloride ratio alone, various *p*H values, and total nickel contents being employed.

3. Soluble Anodes in All-sulfate Baths

Previous data (Appendix 2) indicate that an all-sulfate bath has satisfactory cathode efficiency, but the anodes do not dissolve, causing the *p*H to fall rapidly, and necessitating the addition of nickel salts. To make a fairer test, a diaphragm cell was used, in which the anode compartment contained a Watts solution, to permit anode dissolution, and the cathode compartment contained an all-sulfate solution. The diaphragm used was Amberlite C-1 cation permeable ion exchange membrane (Rohm and Haas). This membrane permits passage of cations such as nickel and hydrogen ions in either direction, but blocks passage of anions such as chloride and sulfate in either direction (see Fig. 1).

Current efficiency and *p*H readings were taken initially and after 24 hours, during which time, 25 amp-hr/gal was passed through the bath. The results obtained are:

	Catholyte		Anolyte	
	Start	End	Start	End
Current efficiency (%)	97.5	97.8	98.2	96.5
*p*H (color.)	3.9	4.3	3.9	3.9
Chloride (g/l)	0.014	0.012	—	—

The electrolytes used and operating conditions were as in Appendix 2. No adjustment of *p*H was made during the run.

Thus, high efficiency plating can be maintained in an all-sulfate bath, while high anode dissolution efficiencies can be maintained by employing a Watts bath in the anolyte, using a membrane which prevents passage of chloride ions. The nickel discharged in the cathode compartment is replaced by nickel diffusing in from the anolyte through the cation permeable membrane. That the solution remains in approximate balance without need for additions of nickel salts or adjustment of *p*H can be seen from the lack of change in *p*H and efficiencies with time, and the approximate balance between anode and cathode efficiencies.

To encourage uniformity in presentation of standard potential data, the convention has been employed in which a positive sign of the potential for the reaction indicates that the reaction tends to proceed in the direction indicated. Cathodic reactions are written as reductions; anodic reactions as oxidations. Thus, the oxidation of zinc metal to zinc ion has a positive standard electrode potential. In many cases, several alternative values of standard electrode potentials, equilibrium constants, and dissociation constants are available. In such cases, the preferred value given by W. M. Latimer, "Oxidation Potentials," (Prentice-Hall, 2nd Ed., 1952) has been used. Where potential data are not given by Latimer, they were calculated by the author using the preferred values for standard free energy of formation data as given by Latimer.

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PRECISION CLEANING AND DEBURRING OF MISSILE GUIDANCE COMPONENTS

by HAROLD W. MUELLER*

INTRODUCTION

In order to build gyros which will give the desired performance in the inertial guidance systems being designed and built at AC Spark Plug Division, diametral clearances as small as 50 millionths of an inch must be maintained between some rotating parts. The frictional torque between these rotating members must not exceed 0.2 dyne-cm.

To illustrate the magnitude of the values involved, let's assume one is holding a wooden stick-match at its end between the thumb and forefinger as a pivot point. The opposite end has the head which one now lights. Immediately after the head is burned the match is extinguished. The change in torque exerted will be reduced by about 200 dyne-cm or approximately 1000 times the maximum frictional torque allowed in some of our gyros. Since a human hair is roughly 0.002 in. in diameter, we can readily see that specs of dust, metal, oxides, lint, epidermies, etc., only 1/40 the diameter of a human hair can cause malfunction. Actually, particles smaller than this cause trouble because several can bunch up in these small-clearance areas.

Our standards of cleaning and deburring must be such that the contamination in our gyros is limited to particulate size smaller than 0.5 μ. The following discussion will attempt to show some of the techniques developed at AC Spark Plug Division to accomplish this objective in the cleaning and deburring processes.

CLEANING

The division's philosophy in cleaning is (a) eliminate the foreign material before assembly in the clean rooms by good deburring techniques (which will be discussed later), (b) in-process stage cleaning, (c) final cleaning of parts just prior to assembly in the clean rooms, (d) flushing the gyros prior to filling with filtered floatation fluid. Some special techniques found to be successful are the following:

Removal of Mold Release. Most mold release compounds are very difficult to remove. Actually, the better the mold release works, the more difficult it is to remove. It must be removed, completely, however, or poor adhesion and flaking of the epoxy resins will occur when these units are subsequently impregnated or encapsulated. Any flaking, even though it may be invisible to the naked eye, cannot be tolerated for obvious reasons. In the case of silicone mold release compounds, for example, it was found that a layer of silicone only one molecule thick, could cause such flaking. Since any solvent used to remove this material would itself be immediately contaminated, a refluxing type still (see Fig. 1) was used to keep clean solvent** in constant contact with the parts to be cleaned.

Stage-Cleaning. In the final stages of gyro buildup solvent cleaning becomes extremely difficult unless as much contamination as possible has been removed in earlier stages of the manufacturing process. In fact, there have been cases where certain organic contaminants were actually cemented to the surface of the part rather than dissolved and removed by the solvent. The only way we could remove it then, since a stronger solvent could not be used at this point, was to abraid it from the surface. Although this type of contamination is usually so small that it cannot be observed with the unaided eye, removal by abrasion is not desirable since it ef-

*Chief Process Engineer, AC Spark Plug Division, General Motors Corporation, Milwaukee, Wisconsin.

**Freon TF, manufactured by E. I. DuPont De Nemours & Co., Inc. Freon Products Div., Wilmington 98, Delaware.

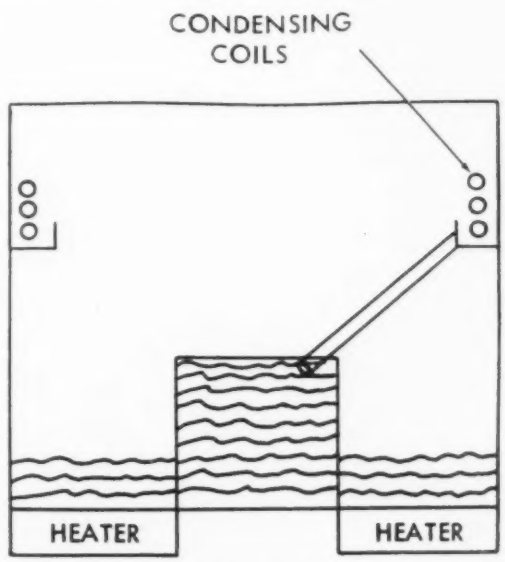

Fig. 1. Refluxing "still" cleaner

fects the critical dimensions involved and adds to the contamination problem.

As a result of this problem a stage-cleaning procedure was developed specifically for gyro parts. Using this procedure, any soils placed on the parts as part of the manufacturing operation are removed immediately before the part moves on to the next operation. A chart describing the four stages involved is shown in Table I.

Reclaiming Stoddard Solvent. The Varsol (Stoddard Solvent) was not clean enough when reclaimed by distillation. It was found that the solvent as received had a 0.006 per cent gum residue by weight whereas our reclaimed solvent had cent gumresidue by weight whereas our reclaimed solvent had 0.034 per cent gum residue by weight. Several changes were made in our distillation procedure, such as returning the first fractions for redistillation and stopping the cycle at a lower temperature than previously.

Redistilling Freon TF. Although the Stoddard Solvent is sufficiently clean as received for its particular application, it is not used in the final cleaning operation. Freon TF was found most applicable for this purpose, especially since disassembled gyros, the parts of which are coated with floatation fluid, must also be cleaned at this stage. One of the reasons Freon TF is used is because it can be obtained in very pure form. However, it must be redistilled before it is used to remove contaminants from the containers. This is done in the still shown in Fig. 2.

TABLE I

STAGE-CLEANING FOR GYRO PARTS

STAGE	TYPE OF CLEANING	SOILS REMOVED
1 ROUGH CLEANING	VAPOR DEGREASING VARSOL SPRAY ACID DIP SOAK CLEAN	OIL TAPPING COMPOUND WAX LAPPING & GRINDING COMPOUND COOLANTS & LUBRICANTS PLATING STAINS
2 PROCESS CLEANING	ELECTRO-POLISHING ALKALIE CLEANING DE-OXIDIZER BATH VAPOR DEGREASING DEIONIZED WATER RINSE	TAPPING OILS COOLANTS & LUBRICANTS WATER MARKS DENTAL BLAST GRIT FINE BURRS PLATING SALTS & OXIDES HEAT TREAT SCALE
3 DEBURRING CLEANING	ULTRASONIC CLEANING (PERCHLOR, WATER-DETERGENT, INHIBISOL, FREON, ACETONE) VARSOL WASH DEIONIZED WATER RINSE FREON DEGREASER WATER-DETERGENT WASH	DENTAL BLAST GRIT LIGHT OILS WATER MARKS FINGER PRINTS RUST-PREVENTATIVE OILS SILICONE MOLD RELEASE SILASTIC PUTTY & TAPE
4 CLEAN ROOM CLEANING	ULTRASONIC CLEANING (PERCHLOR, WATER-DETERGENT, FREON) FREON DEGREASING	FINGER PRINTS LINT DUST EPOXY PARTICLES EPIDERMIS

Microanalysis of Contaminants. To test the effectiveness of the cleaning procedures and the purity of the solvents, some method of microanalysis is obviously necessary. The Millipore filters* have been found very satisfactory for this purpose.

This filter is, essentially, a two-dimensional screen, about 0.006 in. thick, effective as an absolute barrier to particles in the micron or submicron range. This filter is not a fibrous paper or frit. Its surface is pierced with holes or capillaries roughly perpendicular to the filter plane; about 85 per cent of the filter volume is composed of such pores or openings of extreme uniformity leading to extremely high flow rates for this filter.

*Millipore Filter Corporation, Watertown 72, Mass.

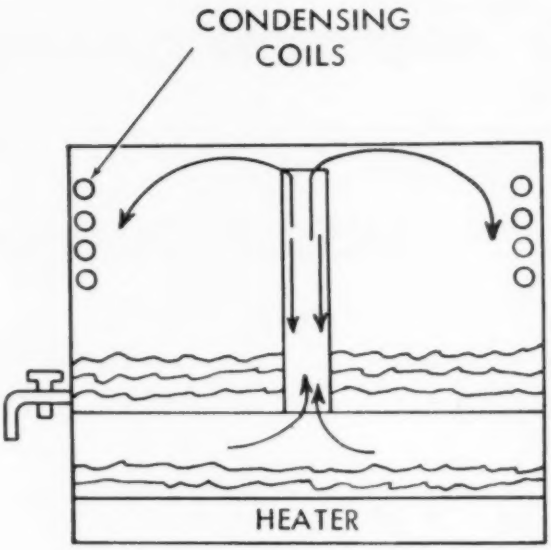

Fig. 2. Schematic of Freon still.

The HA filter, used in most of our applications, for example, has approximately 50,000,000 openings or pores of the size 0.45 μ ± 0.002 μ in each square centimeter. When a liquid sample is filtered through the type HA filter, every particle larger than 0.5 μ is retained, without exception, on the filter surface. For microscopic inspection, the filter body can be made transparent with immersion oil, thus leaving only the contaminants visible.

Ultrasonic Cleaning Applications. Ultrasonic cleaning is used extensively in our stage-cleaning arrangement. To get the optimum results, however, we must use the best solvent; the generator must be of the proper power, frequency and waveform; the liquid level in the tank, the liquid and transducer temperatures, and the impedance match must be correct.

TABLE II

SOLUBILITY OF CONTAMINANTS IN FIVE COMMONLY USED CLEANING SOLVENTS

SOLVENT	ELECTRICAL ASSY		STEEL	ALUM.	EPOXY	BAKELITE	RUBBER	PLASTICS
	WITHOUT WIRES	WITH WIRES						
FREON TF	YES	YES	YES	YES	YES	YES	YES*	YES**
WATER DETERGENT	YES	YES	YES	YES	YES	YES	YES	YES
PERCHLORETHYLENE	YES*	NO	YES	YES	NO	YES	NO	NO
VARSOL	YES	NO	YES	YES	YES	YES	YES	NO
INHIBISOL	YES*	NO	YES	YES	NO	YES	NO	NO

*SHORT TIME IMMERSION ONLY.
**SAFE FOR ALL PLASTICS EXCEPT POLYSTYRENE CONTAINERS.

TABLE III

IMMUNITY OF MATERIALS FROM ATTACK BY COMMONLY USED CLEANING SOLVENTS

SOLVENT	FINGER PRINTS	SILICONES	FLOATATION FLUID	OIL	GREASE	WATER SOILS	FLUX ROSIN
FREON TF	NO	YES	YES	YES	SLOW	NO	YES
WATER DETERGENT	YES	NO	NO	YES	SLOW	YES	NO
PERCHLORETHYLENE	NO	PARTLY	YES	YES	YES	NO	YES
VARSOL	NO	NO	SLOW	YES	SLOW	NO	NO
INHIBISOL	NO	YES	VERY SLOW	YES	SLOW	NO	YES

The selection of solvent is illustrated in the charts of Table II and III. Table II shows the solubility of eight different types of contaminants in five solvents while Table III indicates whethere there is danger that the material of the part itself might be attacked by the solvent.

Power requirements depend on the size and mass of the parts to be cleaned as well as the type of solvent and type of contaminant. Wright Air Development Center Technical Report 56-380[1] contains much valuable information for the proper selection of transducers, solvents, generator frequencies, and waveform. Fig. 3 shows various waveforms produced by commercial ultrasonic generators. These waveforms are not equally effective in removing various types of contaminants

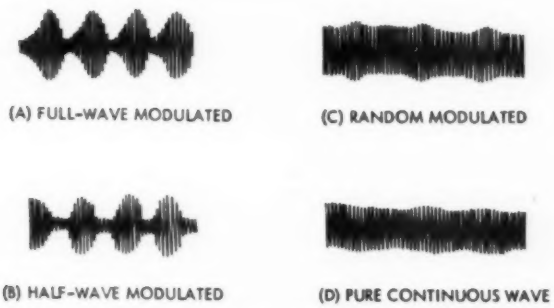

Fig. 3. Types of commercially available ultrasonic generator waveforms.

The full-wave pulse shown in Fig. 3 (a), for example, is most effective in removing certain types of soil from ball bearing assemblies.

Flushing Gyros Before Filling. Although parts are thoroughly cleaned before assembly and the assembly is performed in rooms where the cleanliness is precisely controlled, some contaminants still inevitably get into the gyros. If this particulate matter is not removed prior to filling with floatation fluid, it will naturally migrate and eventually lodge in the minimum-clearance areas. This could cause failure of the gyros some time after they have been incorporated into a complete missile interial guidance system.

To eliminate this problem, special flushing fixtures have been designed and built by the Process Development group at AC Spark Plug Division. These fixtures combine heat, solvent, hydraulic flow, and boiling actions to remove the contaminants. Matter removed is observed on the HA filter previously described. In some cases it is possible at this point to identify the contaminant and eliminate it at its source.

DEBURRING

As mentioned earlier, the 0.2 dyne-cm maximum frictional torque requirements for the gyros can easily be exceeded if foreign particles smaller than 50 millionths of an inch accumulate in certain small-clearance areas. This necessitates removal of "burrs" smaller than that which the unaided eye can see. Consequently, the final deburring and inspection of these parts must be accomplished under 30 to 50 power magnification.

In efforts to meet these requirements many techniques were tried, which include the use of items such as dental tools, wire and bristle brushes and wheels, pencil erasers, ink erasers, abrasive impregnated erasers of varying grit sizes, abrasive impregnated cord, grinding and honing stones of various shapes, sizes and grits, carbide and abrasive burrs, felt shapes and cones, steel wool, emery paper, fiberglass brushes, plastic sticks and lapping compound. Although most of the above are used in hand deburring operations under a microscope or with small bench motors or motorized flexible-shaft chucks, precision mechanized or multiple type processes are used at AC wherever possible.

A brief discussion of specific experiences with some of these processes follows.

Dental Blasting. The Industrial Air Abrasive* unit, which has found limited use in the dental profession, has been an extremely valuable aid in the deburring of tapped holes. In addition to tapped holes, this unit is also used for removing potting material from around terminals and lead wires. Extreme care must be exercised when using this unit, however, since the very fine abrasive-laden air blast is as detrimental to the parent material as it is to the burrs.

Deburring of external threads was mechanized through the design and use of the small reciprocating follower mechanism shown in Fig. 4. This mechanism, when used in conjunction with the dental blaster, causes the part to rotate while the dental blast jet is reciprocated back and forth along the

*S. S. White Dental Mfg. Co., 10 East 40th Street, New York 16, N. Y.

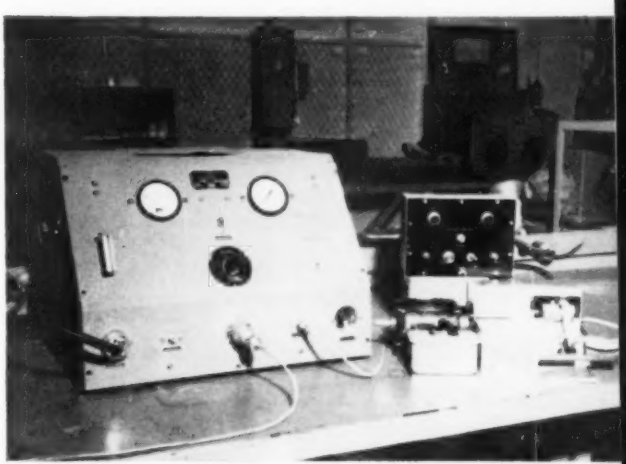

Fig. 4. Mechanized deburring process for screws.

thread. More recently AC has changed to rolled threads and it was found that the burrs on the rolled thread can be removed electro-chemically.

Electro-Chemical Deburring. Many different solutions were tried in a determined effort to apply the principle of electro-polishing to precision deburring. If it were possible to concentrate the action at sharp corners where most burrs exist without materially effecting critical dimensions, the extra cost of duplicate gaging equipment could be avoided.

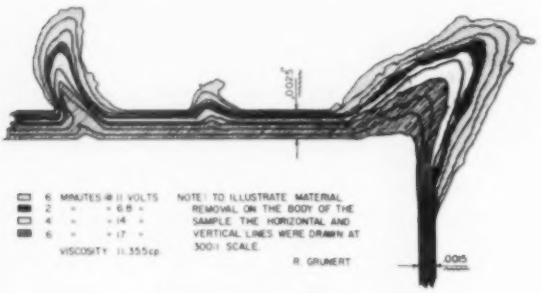
.0025
6 MINUTES @ 11 VOLTS
2 " " 6.8 "
4 " " 14 "
6 " " 17 "
VISCOSITY 11.355cp
NOTE: TO ILLUSTRATE MATERIAL REMOVAL ON THE BODY OF THE SAMPLE THE HORIZONTAL AND VERTICAL LINES WERE DRAWN AT 300:1 SCALE.
R. GRUNERT
.005

Fig. 5. Burr removal by the Battelle Process.

Conforming electrodes were considered for recessed areas as were perforated-tube type electrodes through which the electrolyte could be forced into tapped holes.

One solution used produces a high lustre on the parts and does not require conforming electrodes. In addition, it has more effect at sharp corners and, consequently, is effective in removing burrs without removing much material from other areas. As is shown in Fig. 5, however, some material is still removed from these areas. Consequently, this method of burr removal is usually limited to removing very fine burrs of the type normally removed by hand under a microscope, up to a maximum of about 0.001 in. projection. In some cases this action is still too severe for the more critical dimensions. Some success has been experienced in these cases by applying special masking compounds to these super critical areas; several compounds have been developed which will dissolve into the bath after the desired number of seconds, thus retarding the action on these surfaces as required.

Chemical Milling. Although several proprietary solutions as well as several of our own have been tried to date, AC has not been as successful with this process as with electropolishing.

Molded Deburring Shapes. Considerable success has been obtained in deburring tapped holes and screw threads by molding the thread form into grit-impregnated plastic. The tap mold was then used with a specially designed miniature sensitive tapping head; the screw-thread mold was engaged with the threads of the screw being deburred while the screw was being rotated. These methods have now largely been superseded by some of the processes mentioned previously.

Some work is presently being done, however, in molding complete parts in grit-impregnated plastic or rubber. Sections of this mold are then used as form tools for mechanized deburring. Where clearance is desired for critical surfaces, tape or other masking material is placed on these surfaces prior to molding the part in the grit-impregnated material.

CONCLUSIONS

In an attempt to further reduce deburring costs, many additional processes have been tried, are being tried, or will be tried in the near future. These ideas included such items as:

1. Inspection standards for acceptably deburred parts by encapsulating these standards in transparent plastic.
2. Ultrasonically cleaning deburred parts before inspection to remove all loose particles.
3. A specially designed pressure blast nozzle which will give a swirling action to the air thus allowing the grit to follow down the threads in a tapped hole.
4. Shaker action incorporated into a tumbler.
5. Tumbling action used in conjunction with grit blasting.
6. Combination sliding and rolling action in tumbling.
7. Rotating part in a moving abrasive slurry.
8. Using form tools in machining to eliminate burrs in areas difficult to deburr.
9. Using fluteless taps or rolling internal threads.
10. Redesigning parts or subassemblies to permit more potting or encapsulation, thus permanently trapping the burrs.
11. Using heated taps to deburr tapped holes in plastic parts.
12. Ultrasonic or spark-discharge machining.
13. Plating diamond dust in matrix of copper on taps for use in deburring tapped holes.
14. Ultrasonic deburring.

Recognizing that a creative approach is necessary in order to continuously improve cleaning and deburring techniques, all process engineers at AC Spark Plug Division receive special training in creative thinking. Undoubtedly the precision and accuracy requirements of gyros and other inertial guidance systems components will be continuously increased as we get further into the space age. As a result, ultra-precision cleaning and deburring will very likely become some of our most demanding sciences.

REFERENCE

[1]Investigation of the Applicability of High Frequency Sound Waves (Ultrasonics) for Cleaning of Precision Parts, Mattiat & Zapponi, June, 1957.

Harold W. Mueller is chief process engineer of the AC Spark Plug Division, General Motors Corporation, Milwaukee, Wisconsin. He received a BS in electrical engineering in 1949 and his MS in 1953, both degrees from the University of Wisconsin. Mr. Mueller joined AC Spark Plug in 1949 and after serving in several capacities was named to his present position in 1955. He served in the Signal Corps from 1942 to 1945, for more than two of those years in the Pacific Theatre. He was a contributing editor for the Wisconsin Engineer (1947–48), and is presently production advisor to the Junior Achievement Group sponsored by AC. He is a member of the American Institute of Electrical Engineers and the American Metals Society, and Eta Kappa Nu and Tau Beta Pi honorary engineering fraternities.

PRODUCTION OF URANIUM BY ELECTROLYSIS OF FUSED SALTS†

by CHRISTOPHER MARZANO*

I. INTRODUCTION

Prior to this investigation, several investigators produced uranium by electrolysis of fused salts: Moissan[1] in 1896 electrolyzed the fused double salt of uranium $(NaCl)_2$-UCl_4, in a porcelain vessel which was heated by the plating current and using carbon electrodes. Driggs and Lilliendahl[2] in 1930 developed a process for producing uranium from a bath consisting of KUF_5 and equal parts of sodium chloride and calcium chloride. The container was a graphite crucible which served as the anode; the cathode was a molybdenum wire and the temperature 775C. M. Kolodney and H. L. Slatin[3] produced uranium by electrolysis of high purity materials. In these processes bath temperatures ranged from 500–850C. The product was a fine powdery material which was very pyrophoric and had an undesirably high content of impurities. The purpose of this investigation was to provide a process of preparing uranium metal with a high degree of purity and in a form which could be used for remelting. The author felt that an all chloride system, having a low melting point, with uranium trichloride as the uranium-containing salt, would be feasible for producing uranium.

II. EXPERIMENTAL

(a) Electrolyte

It was necessary to utilize a solvent which would dissolve the UCl_3 and meet the following requirements:

1. It had to be electrically conductive.
2. Freedom from metals which might deposit with, or in preference to, the uranium.
3. Melting point as low as possible so as to minimize the reaction of the solvent with the glass or silica from which an experimental cell could be made.

It was decided to try the eutectic mixture fo lithium chloride (59 mol per cent) and potassium chloride (41 mol per cent) which had a melting point of 352C. It was prepared by fusing reagent grade chemicals in a platinum dish (900C) poured into a platinum tray and allowed to cool. Since the eutectic was hygroscopic, it was kept in sealed containers and heated in an oven to 140C prior to use.

The uranium salt was prepared in 200-gram batches by the method of Johnson and Butler, (c. f. Katz and Robinowitch, 1951).[4] The uranium trichloride, reagent grade, was produced by (1) forming the hydride (UH_3) and then (2) decomposing the hydride with dry hydrogen chloride gas. Uranium turnings were charged into a Pyrex reaction chamber (Fig. 1) and the process carried to completion within this chamber (5–6 hours). The chamber consisted of a Pyrex tube with a standard 71/60 ground taper joint with an inlet for the hydrogen and hydrogen chloride gases. The Pyrex male, standard ground 71/60 taper joint, had a fused Pyrex top, and an outlet for the gases. A schematic diagram of the apparatus is shown in Fig. 2. The uranium trichloride, a green colored, hygroscopic solid, was stored in tightly stopped containers.

The possibility of dissolving UCl_3 in the fused lithium chloride-potassium chloride mixture was ascertained by preparing a series of melts containing different concentrations of UCl_3 by weight in the eutectic. The UCl_3 upon dissolving in the clear, fused eutectic, formed a deep purple colored melt. The colored melt was found to be very soluble in water. Solutions of UCl_3 ranging from 5–50 per cent by weight were prepared. A solution containing 35 per cent UCl_3 began to melt at 385C and completely melted at 400C. An operating temperature of between 400–425C was found to be the optimum. Solutions containing 35 per cent UCl_3 were used for the experimental work.

(b) Electrolytic Cells

The early experimental cells were Pyrex test tubes about 1.5 inches in diameter and 12 inches long. A three hole rubber stopper supported the electrodes and an inlet for a protective atmosphere which could be maintained above the electrolyte. The electrodes were carbon rods and the carbon anode rod was inserted into a Pyrex protective sleeve. The sleeve was sealed at the bottom but had a suitable side opening about 0.5 inch from the bottom so that the anode was in direct contact with the fused melt. The electrodes were loosely held in the rubber stopper which allowed the argon gas to escape. Welding grade argon gas was fed into the cells at a constant rate to protect oxidation of the uranium halide and cathode deposit. The gas was dried before admission into the cell by passing through towers of magnesium perchlorate or calcium chloride or both. Heat was supplied to the cells by individual wrap

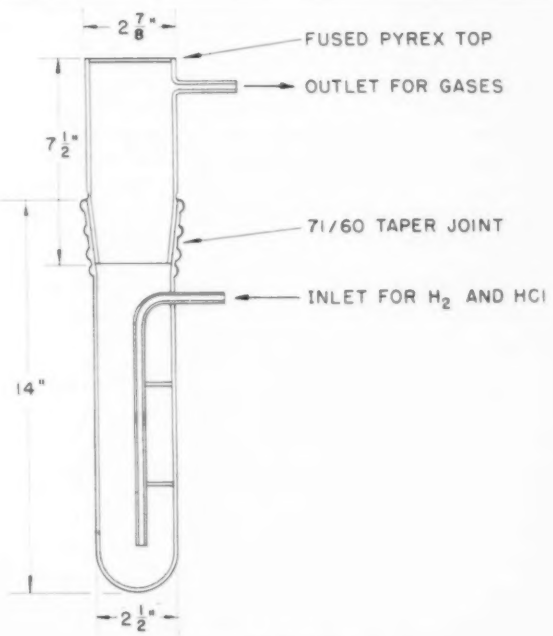

Fig. 1. UCl_3 reaction cell.

† The work was performed by the author when employed at the Argonne National Laboratory, Lemont, Illinois, and recently the work was declassified.

* Chief Chemist, Amphenol Electronics Corporation, Chicago 50, Illinois.

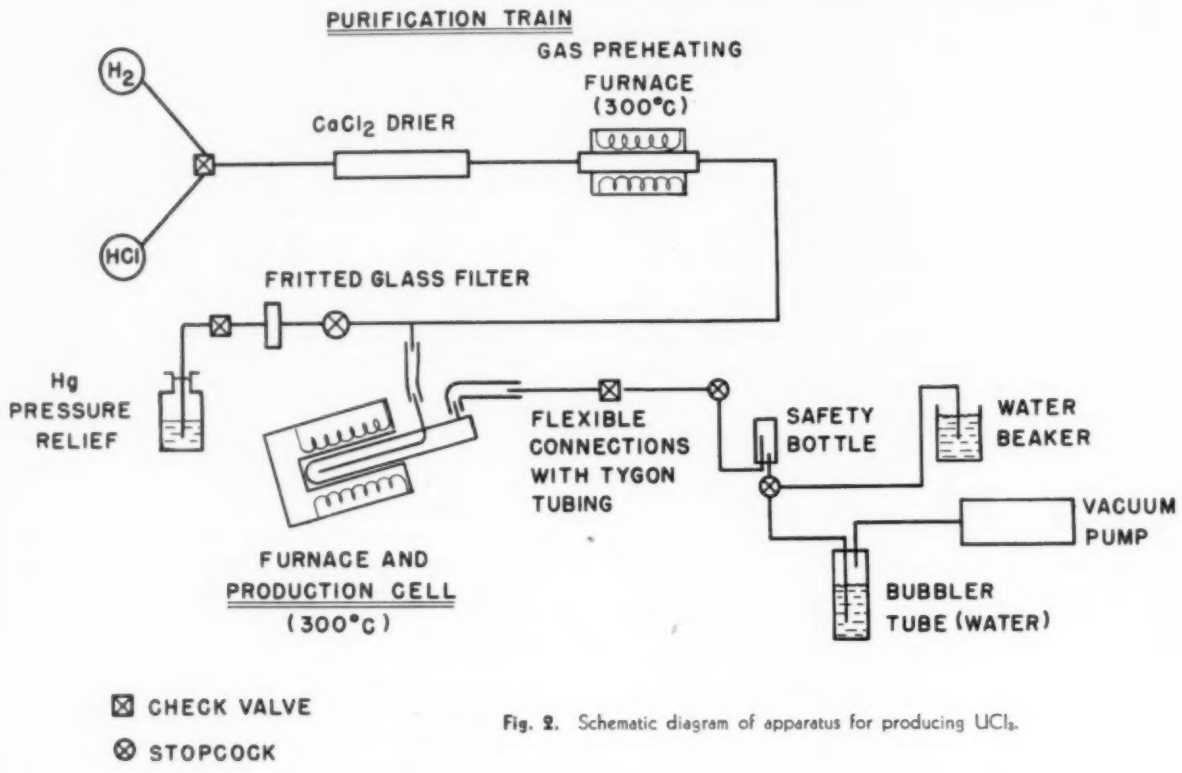

Fig. 2. Schematic diagram of apparatus for producing UCl_3.

around type resistant heaters and the heat input controlled manually by a variable transformer.

The Pyrex cells used to scale up the process resembled the type used for the production of UCl_3 (Fig. 3). The cell consisted of two parts, a bottom section 2.5 inches in diameter and 14 inches long, an open top portion 7.5 inches long, which carried the electrodes and a side inlet for argon gas. Both were connected by a standard ground 71/60 taper joint. The carbon anode, 0.5 inch in diameter, was held by a protective Pyrex sleeve, with a suitable side opening, but sealed at one end so as to prevent the anode from falling to the bottom of the cell. No tube was used for the carbon cathode with the exception of a small pyrex sleeve inserted in the rubber stopper. The cell was tall enough to provide a cooling chamber well above the level of the bath, so that the cathode could be drawn above the fused electrolyte upon completion of the electrolysis and the deposit cooled in the argon atmosphere before removal from the cell.

Pyrex cells were found to be unsatisfactory because they were highly susceptible to stress resulting in unpredictable cell life. A modified quartz or Vycor cell was used throughout the later experimental work. The cells were closed at one end, round-bottom, about 2.5 inches in diameter and 17 inches in length. Cells of this type were found to have a life of several months of continuous operation, but were subject to mechanical damage if the fused melt was allowed to freeze in the cell.

(c) The Electrolysis

The charge was prepared by placing the UCl_3 in the bottom of the cold cell and covering it with the dried LiCl-KCl eutectic. This order gave additional protection to the trichloride until it dissolved in the fused chlorides. A rubber stopper, with a loosely fitted gas inlet tube was placed on the top of the cell, during the heating period, and argon allowed to flow through at a rate of 1 liter per minute. The cell was heated to 450C for about 2 hours and then cooled to the operating temperature of 400–425C. The temporary head was removed and the carbon electrode assembly inserted in the fused melt. Electrolytic runs were made at various voltages which ranged from 0.5–15.0 volts. A current density of from 5–75 amp/sq dm gave the best results. The direct current for electrolysis was supplied by a rectifier. Fine control was effected by adjusting a wire wound resistor in series with the cell. A voltmeter connected across the electrode leads indicated the cell voltage. During the electrolysis, which were run for periods of 6–8 hours and overnight, gaseous chlorine was evolved at the carbon anode. Later, molybdenum rods, 0.5 inch in diameter were substituted for carbon as cathode material and impure soluble uranium rods, also 0.5 in. in diameter as anode material. The soluble uranium anodes were fed into the fused melt by gravity, and no chlorine was evolved during the electrolysis.

It was noticed that electrolyzing at 2 volts resulted in a reasonably constant current density of metal deposition. Upon completion of the electrolysis, the anode and cathode were raised well above the bath level and allowed to cool in the argon atmosphere. After an hour, the electrodes were removed from the cell and plunged into cold tap water. Between runs the electrolyte was protected with argon to prevent oxidation of the uranium trichloride.

Uranium tetrafluoride, UF_4, was substituted for the trichloride in the later electrolytic runs. Uranium tetrafluoride,

reagent grade, had several advantages: (1) it was not hygroscopic, (2) easily handled, (3) readily available, and (4) no need for laboratory preparation. The same concentration, 35 per cent by weight, was used in the make-up of the electrolyte. New electrolytes required a "breaking-in" period of two or three days before clean metal was produced.

(d) The Deposit

The cathode deposit was a dense, interwoven cluster of dendrite crystals composed of fine and coarse dendrites whose individual size varied inversely with current density or applied voltage (Fig. 4). Runs made at lower current densities between 10 and 15 amp/sq dm gave a higher fraction of coarse material and larger dendrites. The size of the crystals ranged from 0.0625 to 0.1250 to $\frac{1}{8}$ inch thick and from 0.250 inch to well above an inch long (Fig. 5). The cathode mass regardless of the applied voltage, grew toward the anode, and if the electrolysis was continued for too long a period of time, the deposit would eventually short circuit the cell.

(e) Recovery of the Deposit

The interwoven mass of crystals on the cathode entrapped a considerable amount of electrolyte which was removed by washing with cold water. The cleaning step was found to be very important because the impurities which collected in the electrolyte seriously lowered the purity of the metal deposit. The following procedure was used:

1) The cathode deposit was allowed to soak in cold water. The crystals then could easily be scraped from the cathode rod.
2) The crystals were washed with running tap water to remove most of the soluble fused salts.
3) The crystals were placed in a fine mesh stainless steel wire basket and swirled in a large beaker of water to remove most of the crystal fines.
4) The crystals were treated with a dilute solution of nitric acid.
5) The crystals were rinsed with distilled water to remove traces of nitric acid. After complete removal of acid the supernatant liquid remained clear (important).
6) The water was decanted; the crystals were rinsed several times with acetone, finally with alcohol, and allowed to dry in the air. The dried crystals were stored in glass bottles for future use.

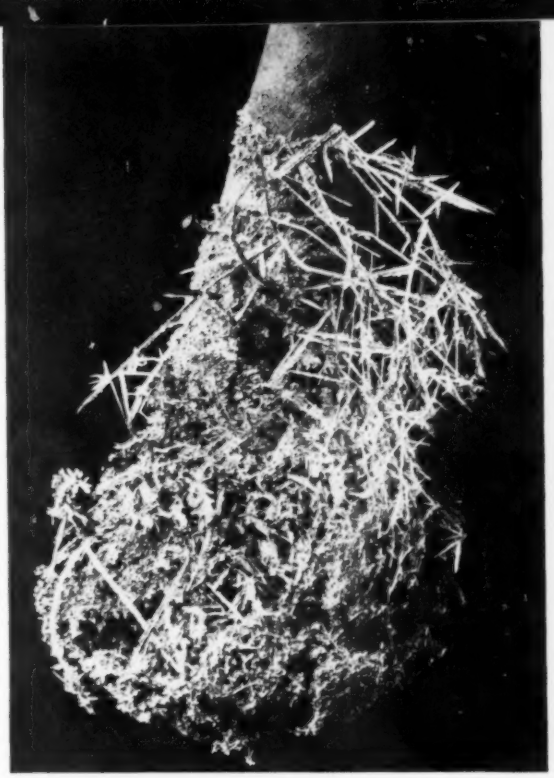

Fig. 4. Metal cluster on cathode.

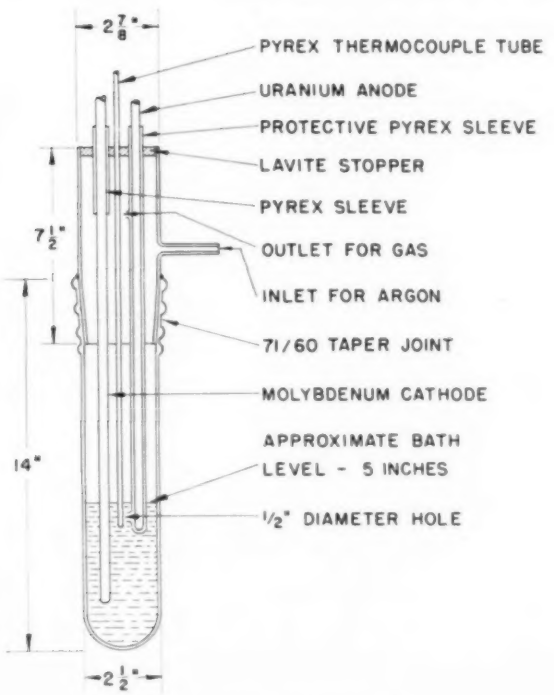

Fig. 3. Vycor electrolytic cell.

III. PURITY OF THE PRODUCT

Representative samples, which were properly cleaned, of the electrolytic runs were almost spectrochemically pure with the exception of lithium and potassium which always appeared in the cathode product. Typical compositions of the uranium metal produced from the UCl_3-LiCl-KCl electrolyte and UF_4-LiCl-KCl electrolyte and using impure uranium anodes in the electrolytic process were as follows:

Carbon	8 ppm
Copper	2 ppm
Iron	1 ppm
Silicon	1 ppm
Lithium	200 ppm
Potassium	200 ppm

Twenty other elements were below the limits of spectographic detection. Variations in the applied voltages had no effect on the purity of the uranium deposits. Removal of electrolyte from the crystals was found to be the important step in the refining procedure.

The mechanisms which may explain the removal of all the impurity elements are not known as yet. Removal of boron and perhaps of silicon may possibly be due to the high volatility of their halides. Some of the other elements such as

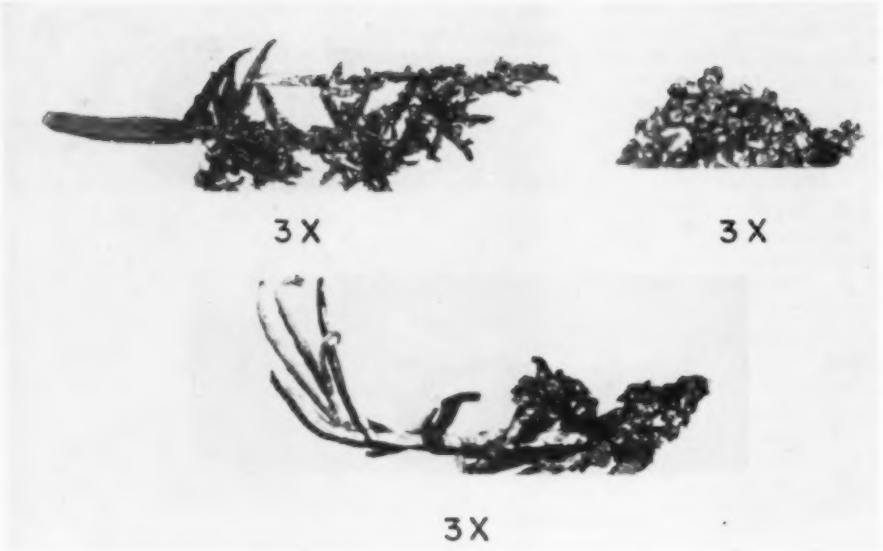

Fig. 5. Individual clusters of crystals.

chromium, copper, and iron may form stable or insoluble complexes. Carbon is very likely insoluble in the electrolyte. Drag-out and bath adjustment of the bath level with fresh eutectic tend to create a composition of electrolyte low in impurities to favor a pure deposit. On operating the fused electrolyte over a long period of time, a viscous sludge collects on the bottom of the cell which contains a considerable amount of impurities.

A minimum of analytical control was necessary to operate the electrolyte over a period of months, because the electrolyte was not sensitive to variations in metal ion content. The alkali metals can be easily removed by melting the uranium in a crucible of uranium dioxide (UO_2), whereby the lithium and potassium are volatilized. The purity of uranium after remelting was 99.993 per cent.

IV. CURRENT EFFICIENCIES

Cathode current efficiencies varied with the cell voltage and a maximum of 60 per cent was reached at two volts. The failure to achieve current efficiencies greater than 60 per cent was due mainly to the loss of very finely divided metal remaining in the electrolyte, by solution treatment with dilute nitric acid and during washing by decantation. Operation of the cell around two volts produced a crystal size very easy to handle and work with. The material balance of the electrolytic process was of the order between 60 and 70 per cent.

SUMMARY

It has been demonstrated that uranium of a coarse crystalline form can be produced by electrolysis of a solution of uranium trichloride or uranium tetrafluoride in a mixture of lithium and potassium chloride at 400–425C. The tetrafluoride proved to be by far the preferred halide starting material. It is advisable to carry out the process in an inert atmosphere to prevent oxidation of the uranium halides and cathode deposit, and argon gas was found suitable for this purpose.

A coarse crystalline product was produced at lower current densities such as 10–15 amp/sq dm. The cathode current efficiency at two volts was in the order of 60 per cent. The preferred cathode material was molybdenum; however, other suitable materials may also be used. When uranium is employed as anode material, the uranium dissolves in the electrolyte, thereby permitting a continuous operation. The purity of the uranium after remelting for removal of lithium and potassium had a maximum of 70 ppm of contaminants.

ACKNOWLEDGMENT

The work on the production of uranium by electrolysis of fused salts was performed under the direction of Dr. Frank G. Foote, Director Metallurgy Division, Argonne National Laboratory. The writer wishes to express his appreciation to Dr. Foote, James F. Schumar and Robert A. Noland for their cooperation and support during the progress of this work.

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Christopher Marzano received a BS degree (1932) and MS degree (1933) in chemistry from the University of Michigan. He entered the plating field in 1940 when he was employed as plant chemist at the Buick Aviation Engine Plant in Melrose Park, Illinois. From 1945 to 1948 he was in charge of production at a large plating job shop, the Chicago Plating Company. He was associated with the Argonne National Laboratory as associate research chemist in the Metallurgy Division (1948–1953). His research work developed a process for the production of high purity uranium by electrolysis of fused salts. Mr. Marzano is now chief chemist of Amphenol Electronics Corporation. He is a member of the Chicago Branch, AES, and is presently serving as publicity chairman for the Branch.

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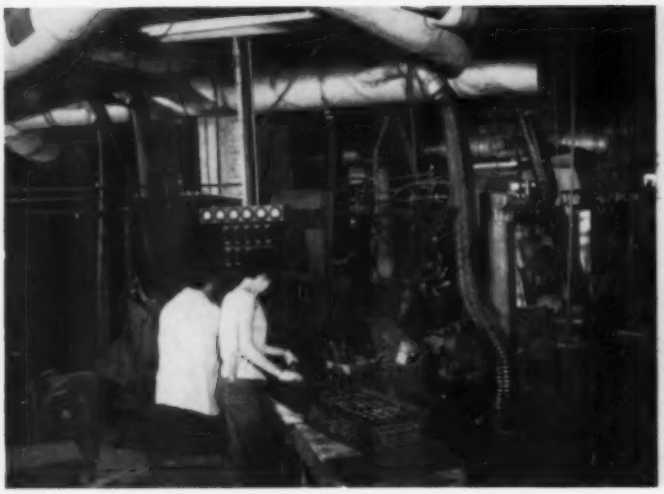


Automatic buffing machines, one pictured, are all equipped with flexible tubing which leads to the dust collector. Each machine has several stations where buffing is done, each is ventilated to prevent dust from being scattered about the working area.

The manual polishing station has each machine equipped with an individual hood for collecting dust and metal particles directly from the polishing wheel. At far left is an empty station showing detail of the hooding construction.

PLATING PLANT TRAPS DUST AT ITS SOURCE

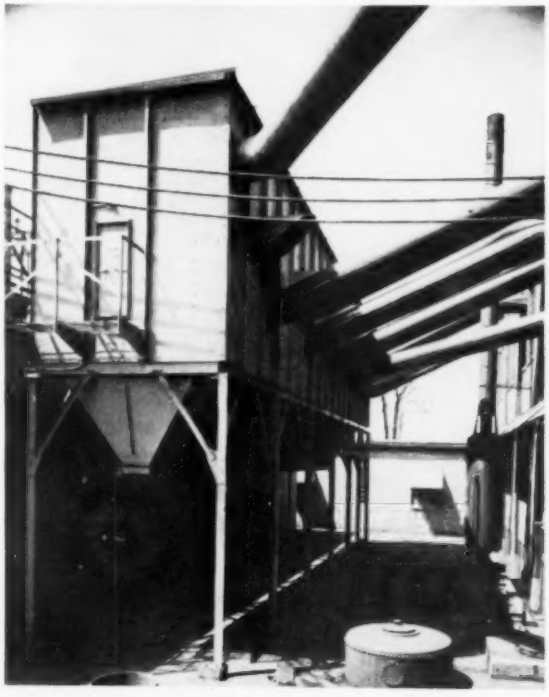
How efficient would a plant operation be with a one-inch layer of dust blanketing the entire area?

Without its dust collection system,* Grand Rapids Plating Company of Grand Rapids, Michigan, probably would have the answer. For 120 cubic feet of dust from grinding, buffing and polishing machines is carted away from its dust collectors each week. In a year's time, this adds up to enough dust to spread a one-inch layer of dust over 75,000 square feet of manufacturing area.

Located near the downtown area of Grand Rapids proper, this plating concern performs the plating operations and the operations required immediately prior to the actual plating for other manufacturers.

As the plant has grown, the Dustube collector installations have been expanded. Although there is no salvage value to the material collected (metallic dust, powdery buffing and polishing compounds and bits of cloth from buffing wheels), the working areas within the plant would become intolerably dusty and would impede the efficiency of the workers. And if the material were vented to the outside without any means for collection, a serious community relations problem could arise because of the proximity of neighboring plants and businesses.

Each of the hand machines and automatic installations for grinding, polishing and buffing is hooded so that contaminants are not permitted to enter the plant air. The vent at each machine leads to a common duct that joins one of several exhaust ducts that lead from the building to the series of dust collectors outside the plant. These collectors are elevated on structural supports, so that a dump truck may be driven beneath the hoppers. The truck moves from hopper to hopper to collect the material that has been filtered out of the air from the plant.



The dust collector, located outside the plant, is fed dusty air by a series of ducts. All ducts visible except the one in the extreme front bring air to the collector. The forward duct returns the cleaned air to the working area.

*Wheelabrator Dustube, Manufactured by Wheelabrator Corporation, Mishawaka, Indiana.

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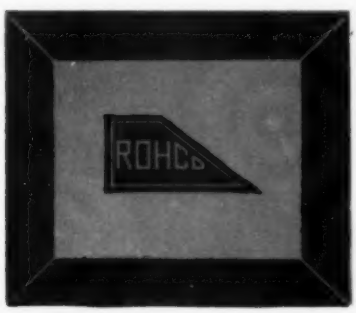

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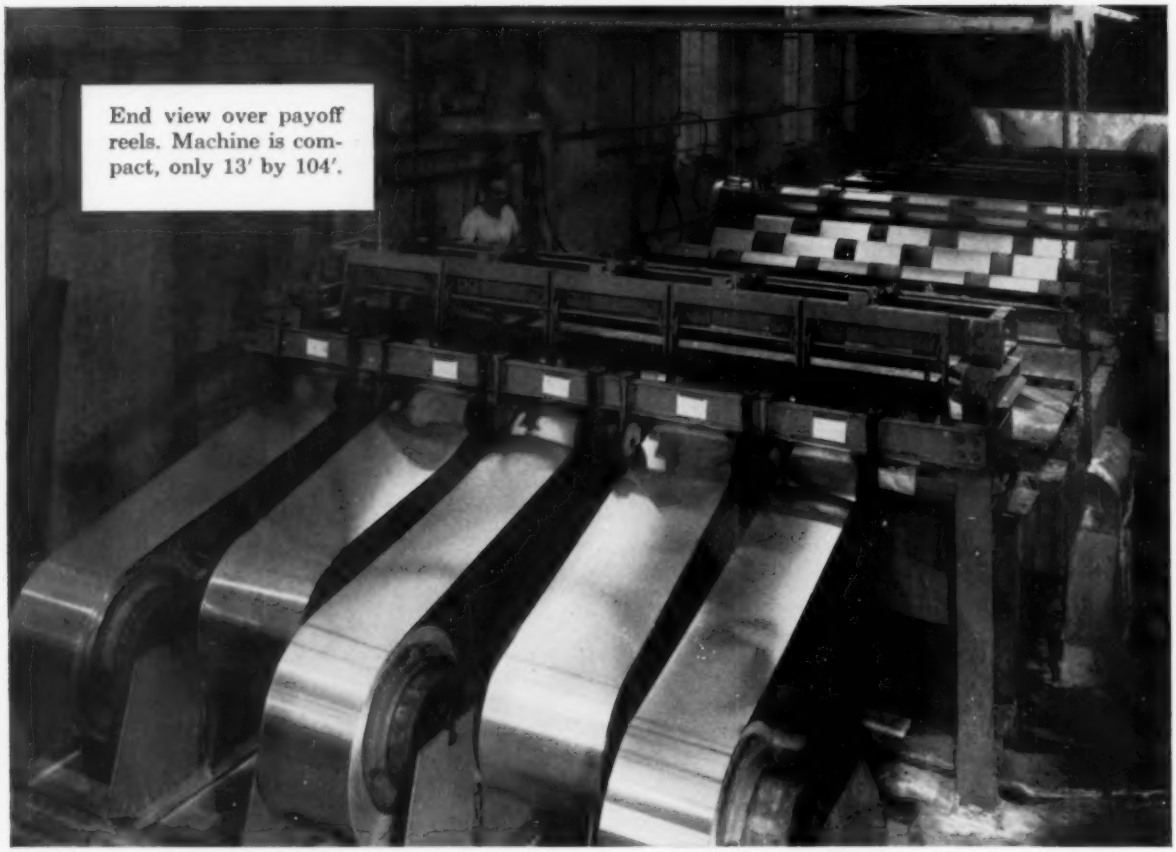

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AES's GOLDEN JUBILEE CONVENTION / EXPOSITION PLANS GAINING MOMENTUM

THE FIFTH INTERNATIONAL CONFERENCE on Electrodeposition and Metal Finishing will be a major feature of the Golden Jubilee Convention and Industrial Finishing Exposition that the American Electroplaters' Society, Inc. (AES) will conduct in Detroit, Michigan, June 15–19, 1959 as climax of the Society's Fiftieth Anniversary observance, with its Detroit Branch as host.

Serving as the educational sessions phase of the AES's Golden Jubilee Convention, the conference is being programmed to present a significant array of scientific and technical papers on plating, corrosion, organic finishing and the chemical and electrochemical finishing of metals. These will be prepared and delivered not only by American experts but also by authorities from other countries.

The tentative program visualizes, to date, some 37 papers by authors from the United States, Canada, England, France, Germany, India and Switzerland. Under authority of the Editorial Board of the American Electroplaters' Society, the International Conference is being planned for the AES by Walter L. Pinner, Chairman of the International Council for Electrodeposition and Metal Finishing, a Past President of the AES and Host Branch Educational Chairman of its Detroit Convention. Other members of the International Council collaborating with Chairman Pinner include: Messrs. T. P. Hoar, S. Wernick, A. W. Wallbank, R. A. F. Hammond, and George Gardam of England and Myron B. Diggin, Dr. Walter R. Meyer and Dr. Richard B. Saltonstall of the United States.

Over a period of five days, the International Conference, at this writing, is expected to include ten sessions. Morning educational sessions will be held at the Statler Hotel, headquarters site of the Golden Jubilee Convention. Afternoon sessions will be held at the Artillery Armory, locale of the AES's Industrial Finishing Exposition.

The opening event of these educational sessions will be the delivery of the William Blum Lecture by Dr. William Blum, first winner of the AES Scientific Achievement Award, the Society's highest honor.

Howard J. McAleer
Exposition Chairman

CONVENTION EXPECTED BREAK ATTENDANCE RECORDS

As the educational sessions element of the AES Golden Jubilee Convention, the Fifth International Conference will provide educational enrichment to the record-breaking number of AES members, their families, guests and many visitors from near and distant lands that are expected to fill not only the Statler Hilton and the Sheraton-Cadillac, headquarters hotels, but also a number of supplementing others.

Under General Convention Chairman Wright Wilson and his functional subchairmen, the Convention Committee is also readying an outstanding program of sport events, entertainment and other relaxational affairs. A well-rounded Ladies' Program is in the making. Taking advantage of the quantity and quality of noteworthy industrial plants in the Detroit area, an interesting program of plant visits is also being fashioned by a qualified committee of this Branch, veteran of four AES National Conventions hosted by it in the past. The Convention's registration fee (male or female) is $20 per person.

INDUSTRY'S SUPPLIERS TO EXHIBIT AT EXPOSITION

Under the leadership of Howard J. McAleer, Chairman, and Manuel E. Ben, Vice Chairman, the Industrial Finishing Exposition itself will be held in the Artillery Armory in nearby Oak Park, and free bus service will be provided between the hotels and the Armory. With nearly 21,000 sq. ft. of exhibit space already purchased by exhibitors at this mid-July writing, this Exposition, the AES's fifth since the Detroit Branch pioneered them in 1947, is expected to assemble for industry display, the products of the largest number of American sources of supply in AES history.

Featuring wide aisles, ample restaurant accommodations offering good food at nominal prices, piped music, a message center and other innovations, the Exposition will also provide abundant lounge space. Among these will be the Fiftieth Anniversary Lounge of the AES and its PLATING MAGAZINE and its Research Program; another sponsored by the magazine *Products Finishing* and another by *Metal Finishing*.

Wright W. Wilson
General Chairman

FIFTH INTERNATIONAL CONFERENCE IN PREPARATION

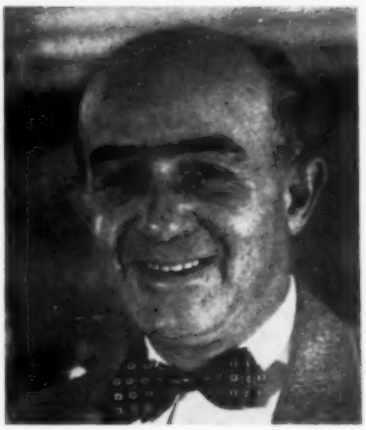
THE INTERNATIONAL COUNCIL for Electrodeposition proudly announces the preliminary program for the Fifth International Conference on Electrodeposition and Metal Finishing, which will occur in Detroit, Michigan, during the week of June 15, 1959. It is my pleasure, as Chairman of the Council, to invite all of those interested in Plating and Metal Finishing to be present. No membership in any technical society is required for your attendance.

There is listed, on the next page, the tentative but quite firmly established program, which will be noted to include the most outstanding authorities in their fields, many of whom are internationally well-known. In eight technical sessions, these experts will discuss new and interesting developments in the fields of Plating, Corrosion and the Chemical and Electrochemical Finishing of Metals. In two additional sessions, the field of Organic Finishing Materials and Processes will be discussed.

The entire conference will cover a span of five days. It will, we are sure, be a program of outstanding caliber. We who have planned it, look forward to welcoming all of you who can attend.

W. L. Pinner

CHAIRMAN



Walter L. Pinner
Chairman
International Council

INTERNATIONAL CONFERENCES ON ELECTRODEPOSITION AND METAL FINISHING

THE CONCEPTION of periodic International Conferences on Electrodeposition came initially from the Institute of Metal Finishing which was then known as the Electrodepositors' Technical Society. It resulted from the observation that, at annual conferences of the Society, there was always a goodly sprinkling of overseas delegates who found it worthwhile to attend such conferences.

The First International Conference was accordingly organized by the Electrodepositors' Technical Society in 1937 in London.

The second such conference was planned for 1939, to be held in Asbury Park, N. J. under the auspices of the American Electroplaters' Society (AES). Such a conference was in fact held but due to the times being unpropitious, there was unfortunately little overseas representation. However, it was counted as International Conference No. 2.

The Third International Conference took place in London in 1947, again under the auspices of the Electrodepositors' Technical Society. It was not until the fourth such conference—held in 1954—that an international organization was created called the International Council for Electrodeposition to plan future international conferences as one of its terms of reference. The initial member organizations of the Council were: The Institute of Metal Finishing (IMF); The American Electroplaters' Society; and a small Belgian technical group interested in electrodeposition. This conference was again eventually organized by the IMF and held in London.

It was then resolved that international conferences should be held at five-yearly intervals and accordingly it was decided that the fifth international conference would take place in Detroit in 1959 with the American Electroplaters' Society as the host organization and the planning to be carried out by the International Council for Electrodeposition and Metal Finishing (organic finishing was now brought into the orbit of metal treatments). Mr. Walter Pinner of the AES was elected Chairman of the present International Council with Dr. S. Wernick of England as Honorary Secretary.

Despite the fact that the members of this Council are separated by a distance of some 3000 miles, the planning of the Fifth International Conference has been going on apace and it is believed that, as a result, there will be very satisfactory international representation both in respect of authors of papers and those attending the Conference.

S. Wernick

HONORARY SECRETARY
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ROSTER OF INVITED SPEAKERS

FIFTH INTERNATIONAL CONFERENCE
on
ELECTRODEPOSITION AND METAL FINISHING

The Educational Sessions Phase of
GOLDEN JUBILEE CONVENTION, AMERICAN ELECTROPLATERS' SOCIETY, INC.
Statler Hilton Hotel, Detroit, Michigan, June 15-19, 1959

COUNTRY	AFFILIATION	SUBJECT
CANADA		
Dr. M. H. Jones	*Ontario Research Foundation*	Influence of Basis Metal
ENGLAND		
A. W. Brace	*Aluminium Laboratories Ltd.*	European Bright Anodizing Practice
Dr. J. Edwards	*The British Non-Ferrous Metals Research Association*	Experiences with the Use of the Sulfur Dioxide Test
Dr. R. A. F. Hammond	*Past President, Institute of Metal Finishing*	Effect of Shot Peening on Fatigue After Chromium Plating
H. D. Hughes	*Wilmot Breeden Limited*	Grain Size Control in Electroforming
U. R. Marx		Pyro-Phosphate Zinc Plating
Dr. W. Stein and D. H. Lloyd		Organic Finishing
A. W. Wallbank	*Ionic Plating Company, Ltd.* *Past President, Institute of Metal Finishing*	Barrel Plating with Special Consideration to Protection of Thread Diameters
Dr. S. Wernick	*Secretary, Past President, Institute of Metal Finishing*	To be announced
FRANCE		
Pierre A. Jacquet	*Consulting Engineer*	Electrochemical Process in Metallography
GERMANY		
H. Spahn		Chemical Polishing
INDIA		
Dr. T. L. Rama Char	*Indian Institute of Science, Bengalore*	To be announced
SWITZERLAND		
J. Zucker		Ultrasonic Cleaning
UNITED STATES		
R. F. Ayres	*Oakite Products, Inc.*	Phosphating
Donald M. Bigge	*Chrysler Corporation*	Experiences with the Use of the Corrodkote Test
Dr. William Blum	*AES Scientific Achievement Award Winner*	The William Blum Lecture
R. A. Boller	*Archer Daniels-Midland Company*	Organic Finishing
E. R. Breining	*The Commonwealth Engineering Company of Ohio*	Gas Plating
Dr. Henry Brown	*The Udylite Research Corporation*	Corrosion Studies
Dr. Charles Faust	*Battelle Memorial Institute*	To be announced
Dr. R. C. Gibson	*Parker Rust Proof Company*	Organic Finishing
Dr. A. Kenneth Graham	*Graham, Savage & Associates*	To be announced
William P. Innes	*MacDermid Incorporated*	Purification of Cyanide Solutions
F. L. LaQue	*International Nickel Company*	Importance of Corrosion Testing
M. D. Levin	*General Electric Company*	Organic Finishing
Dr. Henry Leidheiser Jr.	*Virginia Institute for Scientific Research*	Microthrowing Power
Dr. F. A. Lowenheim	*Metal & Thermit Corporation*	Bronze as a Protective Undercoat for Decorative Finishes
Dr. Abraham M. Max	*RCA Victor—Record Division*	Impurities in Plating Solutions
R. Scott Modjeska	*Scientific Control Labs, Inc.*	Plated Metals for Use in Selective Heat Treating
Cleveland F. Nixon	*General Motors Corporation*	Experiences with the Use of the Accelerated Acetic Acid Salt Spray Test
Myron Perez	*Metal & Thermit Corporation*	Organic Finishing
Dr. Harold J. Read	*The Pennsylvania State University*	Studies Related to Ductility
Dr. Edward B. Saubestre	*Sylvania Electric Products, Inc.*	To be announced
Dr. S. Sterman	*Union Carbide Corporation*	Organic Finishing
William H. McKnight	*Bakelite Co. Division, Union Carbide Corporation*	Organic Finishing
R. V. Vanden Berg	*Aluminum Company of America*	Finishing of Aluminum
R. A. Williams	*Rinshed-Mason Company*	Organic Finishing

Detroit Artillery Armory, scene of the 5th Industrial Finishing Exposition

LIST OF EXHIBITORS 1959 INDUSTRIAL FINISHING EXPOSITION

(As of July 15, 1958)

Abbey Process Automation, Inc.
Abrado Finish Corp.
Acme Manufacturing Co.
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The Udylite Corporation
Unit Process Assemblies, Inc.
United Platers, Inc.
U. S. Stoneware Co.
Vinci Tool & Die
Wayne Industries
Westinghouse Electric Corp.
Wyandotte Chemicals Corp.

LARGEST AES EXPOSITION BEING READIED FOR GOLDEN JUBILEE

To be held in Detroit's Artillery Armory in Oak Park, Michigan, June 15–19, 1959 as a zenith point of the Fiftieth Anniversary observance of the American Electroplaters' Society, Inc. (AES), the AES's Industrial Finishing Exposition has been characterized thus to the industry by Lee G. Belanger of the Behr-Manning Corporation, the Exposition's Space Sales Manager:

> This show will be the largest of its kind held anywhere, and it is combined with an International Conference of metal finishing educational sessions of the highest quality. It offers you the best opportunity to display your wares in the heart of the world's market. . . .

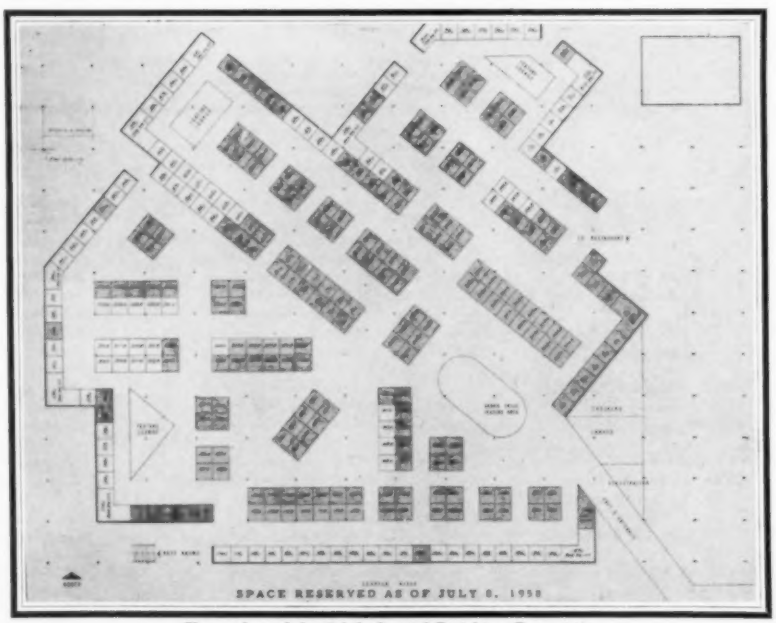
Nearly a hundred exhibitors have already reserved space including the companies (as at July 15, 1958) named in the list presented in an adjoining column. The exhibitors' list is swelling daily.

All exhibits, including the AES/PLATING/Research Program Golden Jubilee feature exhibit, will be in place ready for viewing by the forenoon of Monday, June 15, 1959 and will remain intact until final closing on the evening of Friday, June 19, 1959.

Each contracting exhibitor will be listed in the Exposition Program and Directory and the listing will include both number and list of products displayed. A floor plan is reproduced elsewhere on this page. It is up-to-date as of July 8, 1958.

Howard J. McAleer, President, Formax Manufacturing Co. of Detroit is the AES's Exposition Chairman with Manuel E. Ben, General Motors Corporation, as Vice Chairman. Robert C. Trees, The Udylite Corporation, is the Exposition's publicity chief.

In addition to its industrial attractions, Detroit will have much else to offer AES during its Golden Jubilee Convention and Exposition in June 1959, including Greenfield Village; Edison Institute; Cranbrook; Belle Island; the city's natural moat Zoo; automobile plants; the new waterfront; moonlight cruises to Bob-Lo and the S. S. Aquarama Cruises. For AES, DETROIT'LL SHINE IN '59.



Floor plan of the 5th Industrial Finishing Exposition

MILESTONES OF AES

A PLATING MAGAZINE original feature during this observance fiscal year of the FIFTIETH ANNIVERSARY of its parent, American Electroplaters' Society, Inc.

"I shall pass through this world but once. Any good thing, therefore, that I can do, or any kindness that I can show to any human being, let me do it now. Let me neither defer nor neglect it, for I shall not pass this way again"
—Amiel

THAT'S the motto of the National Electro-Platers Association of the United States and Canada (NEPA) that became today's American Electroplaters' Society (AES) in June 1913—a maxim so cherished by NEPA's founding fathers that it prefaced the very preamble of NEPA's Constitution and Bylaws.

Charles H. Proctor
First President, NEPA

Structurally, NEPA was a non-profit educational association domiciled in New York and incorporated under that state's statutes for the principal purposes of, 1) advancing and disseminating "knowledge concerning the art of electro-deposition of metals," 2) maintaining a laboratory equipped for research work, 3) conducting meetings for the purpose of presenting papers upon appropriate technical and scientific subjects and 4) publishing technical literature.

Its three classes of members consisted of 1) Active Members who had to be foremen electroplaters and electrochemists, 2) Associate Members who were employees of supply houses and 3) Honorary Members who were men of "knowledge preeminently valuable to the Association."

It had a Board of Trustees consisting of five members, three of whom had to be electroplaters. Its officers numbered seventeen and included a President, ten Regional Vice Presidents, a Recording Secretary, a Corresponding and Financial Secretary, a Treasurer, a Librarian, a Sergeant-at-Arms and an Assistant Sergeant-at-Arms.

The Association met monthly on the first Saturday of each month. Annual dues for Active Members were $5—for Associate Members, $3. NEPA's President could grant a Charter to any applying body of foremen electroplaters and electrochemists if such body's application was approved by two-thirds of NEPA's members.

TO ASSIMILATE NEPA's nearly half-decade progress, that Association became today's American Electroplaters' Society in 1913, the change being formalized and finalized at the AES's First Annual Convention, an assembly held in New York City on June 1 of that year, in the very wake of the inauguration of Woodrow Wilson as our nation's 28th President. The late George B. Hogaboom was elected AES's first National President.

"The object of this Society," stated Article 1, Section 2 of its Constitution, "shall be the improvement and dissemination of knowledge concerning the art of electrodeposition in all its branches. All laws and rules," it continued, "must be so formed that the Society will promote no other object than the education of its members in all the principles of electrodeposition and coloring of metals."

George Hogaboom
First President, AES

Then as now, the AES's summit governing council was the Supreme Society composed of three Active Members from each "Branch Society." According to the Constitution, the Supreme Society was "the Supreme Court of the entire Society" and its decisions were, as now, final.

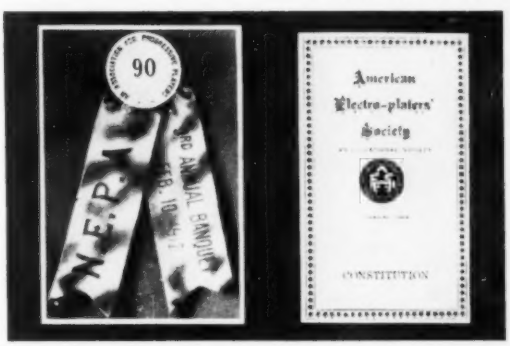
Leadership was then composed of the National President, a First and Second Vice President, a Secretary-Treasurer and an Editor. These plus the immediate Past President composed the Executive Board. The principal office of the Society was New York and AES, as NEPA's continuing entity, was a New York State non-profit corporation.

AES was required by its Constitution to maintain a publication ("QUARTERLY REVIEW" which became "MONTHLY REVIEW" in 1914, direct ancestor of today's PLATING MAGAZINE) but, at that stage, held that, "no member of any 'Branch Society' shall permit said publication to be used by anyone not entitled to the information contained therein."

As in NEPA, the membership classifications of AES were 1) Active Members; 2) Associate Members and 3) Honorary Members. The Society's then fiscal year commenced on June 1. The dues of members of "Branch Societies" were $5 per member per year. Each "Branch Society" had to pay a 35 per cent per capita tax for the maintenance of the Supreme Society, and this tax was payable annually in four quarterly installments namely August 15, November 15, January 15 and May 15.

Though today's AES's Constitution and Bylaws are modern instruments kept apace of changed times and changed needs, it is nevertheless amazing that so many of today's AES policies stem basically from the principles enunciated in that pioneering instrument framed by AES's founding fathers nearly a half-century ago. It supports the contention that any enterprise that survives competitive struggles for some five decades must surely have pursued, in its lifetime, essentially sound and durable guiding principles.

—JOHN P. NICHOLS



DETROIT BRANCH STAG DAY ACTIVITIES AT HILLCREST COUNTRY CLUB, JULY 26

(1) Teeing off on Hillcrest's famed course. The first foursome teed off at 5:06 a.m. (2) Archery drew many contestants. (3) Horseshoe pitching was most popular game. Winners were J. Fantazzo and A. Rozzman. (4) Head table at luncheon: Robert Spaulding, program chairman; Detroit Branch President Manuel E. Ben, International Conference Chairman Walter L. Pinner, National Executive Secretery John P. Nichols, Stag Day General Chairman John F. Siefen, National President Herberth E. Head, Golden Jubilee Convention General Chairman Wright W. Wilson, "Products Finishing" Editor Ezra A. Blount, John B. Hitchcock, ticket chairman. (5) A pause to refresh. (6) Nearly 300 competed in putt luck. F. Angerelli of Acme Manufacturing Co. was the winner. (7) Bait casting under professional auspices. (8) Choice buffet after a funfull day. (Photographs Courtesy of Andy Catchmark, Chrysler Corporation; Robert C. Trees, Udylite Corporation)

AES NEWS

BRENNER ELECTED CHAIRMAN OF AES AWARD SELECTION COMMITTEE

To the Committee's chairmanship, members of the AES Scientific Achievement Award Committee recently elected Dr. Abner Brenner succeeding Dr. Russel E. Harr who served in that capacity last year, the Committee's first in existence.

Task ahead of Dr. Brenner and his Committee is to select the second AES Scientific Achievement Award winner from among nominations soon expected from respective AES Branches. Dr. William Blum, at the recent AES Cincinnati Annual Convention, was declared the first winner of that AES highest award and will consequently deliver the first "William Blum Lecture" at the opening session of the Fifth International Conference on Electrodeposition and Metal Finishing, educational highlight of the AES Golden Jubilee Convention to be held in Detroit, June 15–19, 1959.

Second winner of that annual award will be announced by Dr. Brenner at the Opening Session of the Detroit Convention and he will deliver the second "William Blum Lecture" at the AES's Los Angeles Convention in 1960.

Every accredited Delegate will soon receive a Ballot from the National Executive Secretary for Branch nominations for the Award. In due time, all such Branch nominations will be transmitted to Dr. Brenner's Committee for final selection of the winner. The Committee includes Myron B. Diggin, Dr. Russel E. Harr; Dr. Samuel Heiman; Dr. Edward A. Parker and Dr. Louis Weisberg.

GLOVER AND NIXON HEAD MAJOR COMMITTEES

Aside from Chairman Manson Glover, Glover Coating Co., the 1958–1959 Law Committee recently appointed by National President Head includes Myron B. Diggin, Hanson-Van Winkle-Munning Co.; and Past Presidents William J. Neill, Columbus Metal Products, Inc. and Samuel S. Johnson, Weirton Steel Co.

Chairman of the 1958–1959 Credentials Committee is Past President Cleveland F. Nixon with Past Presidents George J. Wagner and George P. Swift comprising the balance of this Committee whose immediate function ahead will be to accredit the AES 1958–1959 roster of Delegates/Alternates composing the Supreme Society, the AES's highest governing council.

DETROIT BRANCH'S LEADERSHIP PLANNING ITS GOLDEN JUBILEE EVENTS

Around the table, left to right: Leland M. Morse, Branch Delegate, Supreme Society; Vincent Cassidy, Chairman, Educational Committee; Donald M. Bigge, Chairman, Membership Committee; J. D. Thomas, Member, Board of Managers; Edward J. Kubis, Secretary-Treasurer; John B. Hitchcock, Stag Day Chairman; Manuel Ben, Branch President; Wright W. Wilson, General Convention Chairman; Robert C. Trees, Chairman, Branch Public Relations Committee; Cleveland F. Nixon, Chairman, Branch Long Range Planning Committee; Herberth E. Head, National President of AES; Joseph Gurski, Branch Delegate; Carl O. Durbin, Chairman, December Christmas Party; John F. Siefen, Member, Board of Managers.

DETROIT BRANCH STAGES BANNER GOLDEN JUBILEE MIDSUMMER STAG DAY

With nearly a thousand members and guests participating, the Detroit Branch, host of next June's Golden Jubilee Convention and Industrial Finishing Exposition, warmed up for that vast Anniversary enterprise by conducting a 1958 Stag Day that, at very least, matched the quality of any of its five successful predecessors.

Held at the Hillcrest Country Club, the day's timetable ran the gamut of contests—from golf to tug-o-war—from putt luck to egg throwing—from bait casting to horseshoes and archery—from bumbleball to baseball.

Under the General Chairmanship of John F. Siefen, with Robert Spaulding as Program Chairman, a well-organized group of committees provided effective management to the day's respective phases, thus enhancing general enjoyment. There were prizes galore—and every person received at least one. Nearly all had the AES's coat of arms imprinted or embossed thereupon. And, affixed to the facade of two sides of the clubhouse were the AES's Golden Jubilee flags as reminders of the Anniversary observance in progress and its Detroit climax ahead next June 15–19.

Aside from the current and past leadership of the Detroit Branch and AES Past Presidents Cleveland F. Nixon, Walter L. Pinner and Ellsworth T. Candee, the guest list included, among others, National President Herberth E. Head, First Vice President Ralph D. Wysong, Third Vice President Chester G. Borlet, National Executive Secretary John P. Nichols and *Products Finishing* Editor Ezra A. Blount.

John B. Hitchcock served as Ticket Chairman, W. Katke as Dinner Chairman. Game Chairmen included B. A. Matrille, U. C. Jones, P. J. Driscoll, R. Lang, M. A. LaBoda, D. Agresta, J. Dymkowski, J. Putnam and J. D. Johnson. Present and active were Branch President Manuel E. Ben; First Vice President Donald M. Bigge; Secretary-Treasurer Edward J. Kubis; General Convention Chairman Wright W. Wilson; Exposition Chairman Howard J. McAleer; Publicity Chairman Robert C. Trees and International Conference Co-Chairman Myron B. Diggin.

The next major Detroit Branch event during the Golden Jubilee will be its Annual Educational Sessions and Banquet, December 5–6. Then ahead will be the Golden Jubilee Convention and Industrial Finishing Exposition, including the Fifth International Conference on Electrodeposition and Metal Finishing, where, for AES and its members and Branches, DETROIT'LL SHINE IN '59.

DUE DATES FROM AES BRANCHES

OCTOBER 15	Return Sheets from accredited Delegates covering Branch Nominations for AES Scientific Achievement Award.
NOVEMBER 3	Return Sheets signed by both the Branch President and Branch Secretary designating and certifying the Branch's duly elected Delegates and Alternates for Credentials Committee accreditation. The tenure of these Delegates will be from the first Branch Meeting following the 1958 Cincinnati Convention to the first Branch Meeting following the 1959 Detroit Convention.
DECEMBER 1 (September if possible)	Per Capita Taxes for all Branch Members in good standing covering the 15-month period from April 1, 1958 through June 30, 1959.

SOUTHERN TIER'S GALA JUBILEE YEAR PICNIC

The annual picnic of the Southern Tier Branch was an unusually festive occasion this summer. It had been proclaimed a "Jubilee Year Gala Affair" in celebration of the Golden Jubilee Year of the American Electroplaters' Society and it more than fulfilled everyone's anticipation.

The picnic was held on Saturday, August 23 at Taughannock Falls State Park, located on the shores of beautiful Cayuga Lake, about eight miles from Ithaca, New York.

The platers brought their wives and children and all indulged in the games that made the picnic so enjoyable. Sumptuous refreshments quelled ravenous appetites.

John J. Bunsic, shown below with his wife during a recent visit to the Newark headquarters of the American Electroplaters' Society and PLATING, was chairman of the annual picnic. His committee was comprised of S. Stefanski, C. Emery, J. McCarthy, A. Fletcher and R. Wheeler. Morgan Rake, S. Botting, L. Rood, C. Harris, G. Zurenda and C. Bounds had charge of tickets.

More details and pictures will appear in the October issue.

Mrs. and Mr. John J. Bunsic

DIXIE'S "GOLDEN JUBILEE" REGIONAL TECHNICAL SESSIONS AND BANQUET COMMITTEE

Left to right, seated, Bob M. Taylor, Southeastern Branch 1st vice president; Claude J. Nalley, Southeastern president; Myron M. Randman, committee general chairman; Herschel R. Stogner, Sr., Branch and committee secretary-treasurer. Standing, John E. Varner, program chairman; Mrs. Myron M. Randman, ladies program; George W. Taylor, board of managers Southeastern Branch; Mrs. Charles I. Lewis, ladies program; William F. Kelly, publicity chairman; Mrs. William F. Kelly, ladies program; Charles I. Lewis, plant visitation chairman and Southeastern board of managers; Clyde Stovall, Southeastern board of managers; Fred Fulforth, Sixth Interim Meeting coordinator. Committee members not present, Justus U. Bellville, entertainment chairman; Richard R. Russell, registration chairman and Jerita D. Wilson, educational chairman.

EVENTFUL SIXTH INTERIM MEETING TO BE HELD IN DIXIE

Being programmed by the Dixie Regional Group as a feature of the AES's Golden Jubilee observance, with the Southeastern Branch as host Branch, the SIXTH INTERIM MEETING of the Supreme Society will be held at the Dinkler-Plaza Hotel, Atlanta, Georgia, Saturday, February 14, 1959 concurrently with that dynamic group's two-day "First Dixie Regional Technical Sessions and Banquet." (February 13–14).

Preliminary plans rapidly being perfected by an experienced Committee call for a full-day of educational sessions and relaxation on Friday, February 13 followed by the Supreme Society meeting on Saturday. An interesting Ladies Program is in the making. Against a Fiftieth Anniversary background, the gala banquet will be held Saturday evening. Other attractions are being blueprinted to make that mid-winter assembly of the Society's governors a memorable Golden Jubilee event.

Above, the leadership and personnel of the Committee.

DOWNTOWN ATLANTA. SITE OF THE AES SIXTH INTERIM MEETING

Left foreground, Georgia State Capitol, State Office Building, City Hall and Fulton County Court House and Administrative Building. Modern expressway system shown in upper right-hand corner.

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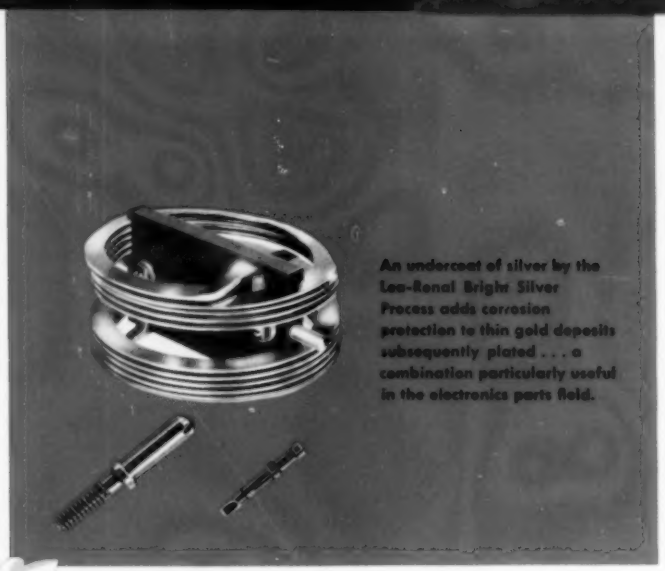

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Cleaning and Preparation of Metals for Electroplating, IV, V, VI & VII—By H. B. Linford & E. B. Saubestre	*Serial 26* *Project 12* **$3.50**
Methods for Testing Thickness of Electrodeposits, II & III—By H. J. Read & F. R. Lorenz	*Serial 27* *Project 7* **$1.35**
Porosity of Electrodeposited Metals—By N. Thon, D. G. Kelemen, L. Yang, S. Yang, D. Dean	*Serial 28* *Project 6* **85 Cents**
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Effect of Impurities and Purification of Electro-Plating Solutions, VII & VIII—By D. T. Ewing, J. K. Werner, A. A. Brouwer, C. J. Owen and W. O. Dow	*Serial 32* *Project 5* **$1.00**
How the Small Electroplater Can Treat Cyanide Plating Waste Solutions with Hypochlorites—By Barnett F. Dodge and Walter Zabban, Yale University, New Haven, Connecticut	*Serial 33* *Project 10* **50 Cents**
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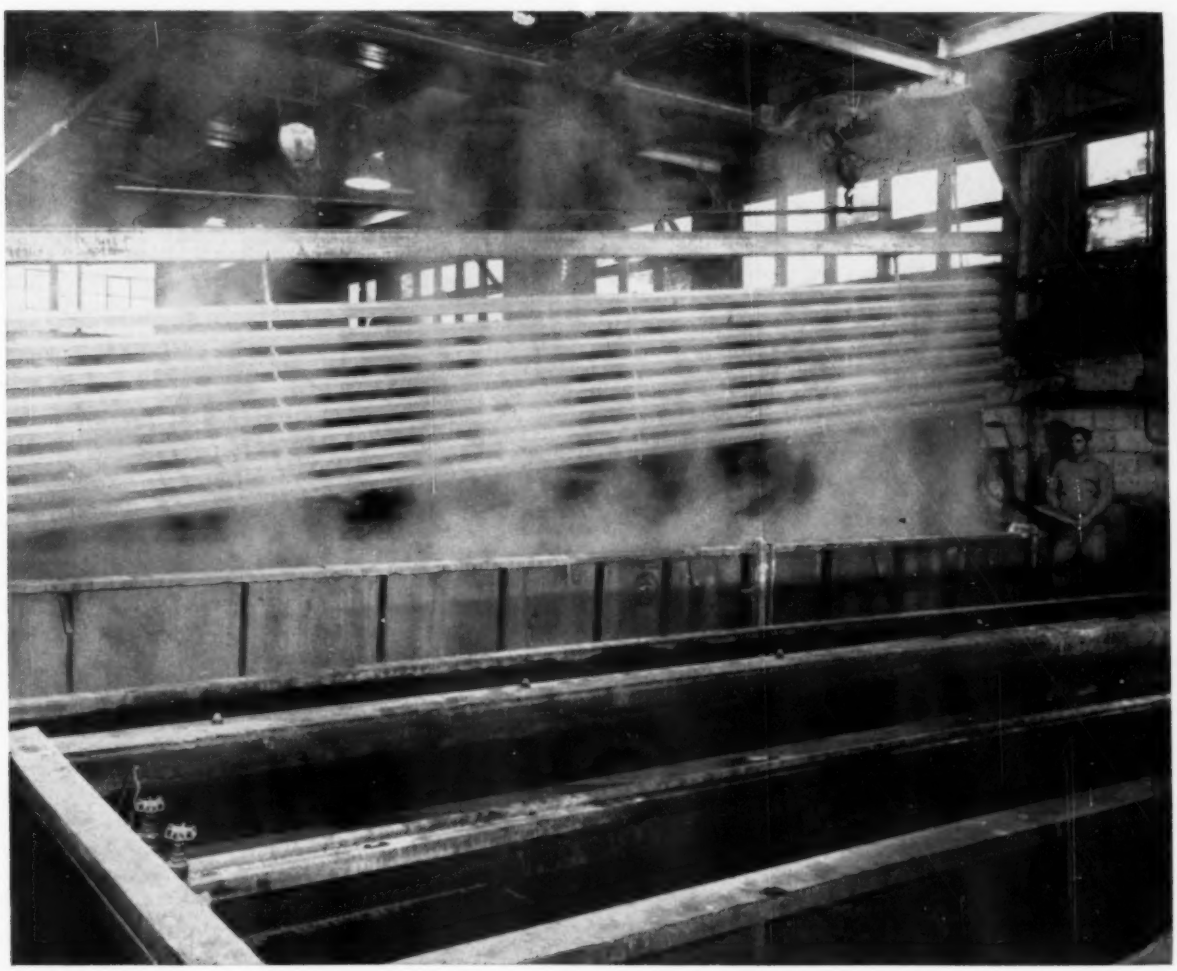

INTERSOCIETY NEWS

HULL NACE SECRETARY

T. J. Hull has assumed his new duties as executive secretary, National Association of Corrosion Engineers. R. W. Huff Jr. has become assistant executive secretary. Mr. Hull had been assistant executive secretary for the year preceding. A. B. Campbell, former executive secretary, retired March 31.

Mr. Hull joined NACE in February, 1952. He was in charge of NACE Central Office work with regions and sections for two years and then became technical secretary, a position involving the association's technical committees. During World War II he was in the U. S. Navy, with service totaling seven years. He attended the U. S. Naval Academy and holds a BS degree in mechanical engineering from the University of Houston.

Mr. Huff, prior to assuming his new post, had handled various administrative details of the association's activities, particularly in connection with annual conferences and exhibits held by NACE, and with NACE membership activities in regions and sections. He is a graduate of Texas A & M College with a BS in chemical engineering. He served in the Air Force during World War II. He is married and has a daughter.

A. B. Campbell, who retired March 31, had been executive secretary since 1946. At that time, NACE had 870 members, about one-sixth its present number.

SAM TOUR AWARDS GIVEN AT ASTM MEETING

W. G. Renshaw and R. A. Lula, Research and Development Laboratories of the Allegheny Ludlum Steel Corp., were honored June 25 during the 61st Annual Meeting of the American Society for Testing Materials at Boston, by receiving the Sam Tour Award for their paper on "The Corrosion Properties of Chromium-Nickel-Manganese Austenitic Stainless Steel." This award was established to encourage research on the improvements and evaluation of corrosion testing methods and to stimulate technical papers in this field.

Mr. Renshaw has been engaged in corrosion work for many years and is the author of several papers on stainless steel and titanium. He is currently supervisor of the corrosion section of the research and development laboratory of Allegheny Ludlum Steel Corp. Since 1956, he has been a member of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

R. A. Lula, chief research metallurgist, stainless steel section of Allegheny Ludlum Steel Corp. Research and Development Laboratories, is a graduate of the University of Bucharest and Carnegie Institute of Technology. Since 1955, he has been a member of ASTM Committee A-10. He is the author of several papers on stainless steels.

WECK TO LECTURE AT ASM SEMINAR

One of the world's foremost authorities in the field will be lecturer for an important "Seminar on Residual Stresses" to be conducted in Cleveland Oct. 30–Nov. 1 by the American Society for Metals.

He is Professor Richard Weck of Cambridge University, England, director of the British Welding Research Association, author of several standard engineering texts in the field of metals stresses and chairman of the Commission on Residual Stresses of the International Institute of Welding.

Dr. Weck, educated at Prague University and Cambridge, will deliver a series of lectures during the seminar, in the Wade Park Manor, Cleveland.

The seminar is a forerunner of a major scientific and educational program being developed by the American Society for Metals as part of its long-range "ASM of Tomorrow" project.

To be created in the future is a Metallurgical Seminars Division of the Society. Blueprinted are one-week and two-week seminars—both to provide working metallurgists with comprehensive "refresher" material within their field and to facilitate exchange of latest information within the profession on new methods, materials and processes.

SCHAEFER TO FILL OUT EISENMAN TERM

Adolph O. Schaefer, president, Pencoyd Steel and Forge Corp., Philadelphia, has accepted appointment by the board of trustees of the American Society for Metals to the unexperied term of secretary of the society following the recent death of founder-member William H. Eisenman, who for forty years had served as national secretary.

Ray T. Bayless, long-time assistant secretary of the society, will continue in this position and will become, in addition, temporary manager to direct activities at the headquarters offices in Cleveland.

Mr Schaefer is a past president of the Society and has been active as a national trustee and in local affairs of the Philadelphia Chapter, having served as secretary, treasurer and chairman of the local group. A graduate of the University of Pennsylvania, he has been associated with many activities in the metal industry. He received the Delaware Valley Metals Man of the Year Award from the Philadelphia Chapter in 1954.

Mr. Bayless was the society's first employe, having been hired in 1922. He was graduated in 1914 from the University of Michigan with a degree in chemical engineering. One of his major responsibilities has been as editor of Transactions, the annual proceedings of the society.

FRIEDT HEADS NAMF CONVENTION

Glenn H. Friedt Jr., vice president of United Platers, Inc., Detroit, is general chairman of the 1959 convention committee of the National Association of Metal Finishers.

Serving with Mr. Friedt are Webster B. Knight Sr., president of Knight Plating Co., Detroit, convention co-chairman, and Edward N. Marlette, president of Marlette Plating Co., Buffalo, educational chairman.

The 1959 NAMF conclave will be held in Detroit from June 14 to 16, at the Hotel Statler. A general meeting of the membership, elections, committee meetings, a 2-day management seminar, and the traditional banquet will highlight the 3-day convention of job shop owners and operators.

General chairman Friedt is past president of the Detroit Branch of the American Electroplaters' Society; past chairman and director of the Plating Institute of Michigan; and former director of the NAMF.

61st ANNUAL MEETING OF ASTM

A varied technical program useful to industry and commerce covered a wide range of important authentic data on materials at the 61st Annual Meeting of the American Society for Testing Materials held at the Hotels Statler, Sheraton-Plaza and Bradford at Boston, June 22–27, 1958. Highlighting the technical program were symposiums on Materials Research Frontiers, Radiation Effects on Materials, Bulk Sampling, and Particle Size Measure-

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ment. The annual Marburg and Gillett lectures on "Man and Raw Materials" and "High Temperature Metals—Their Role in the Technological Future," respectively, emphasized both encouraging and discouraging aspects of our raw materials and minerals supply situation.

At four industry luncheons, outstanding speakers appraised the present situation and conjectured on the future of their respective industries.

A recorded attendance of 2988 for the technical program again made the meeting the largest in the society's history. In addition, there were 42 technical sessions and over 800 technical committee meetings during the five-day meeting. The work of the society's numerous technical committees for many months was concluded with the presentation of their reports at the meeting.

A program was provided by the local committee to entertain the more than 500 ladies who took this opportunity to visit Boston and New England, many for the first time. Sightseeing trips and visits to historical and cultural points of interest were arranged, as well as friendly morning "coffee hours" at which to get acquainted.

A "night at the Pops" with dinner and a special concert by the Boston Pops Orchestra under the baton of Arthur Fiedler provided an enjoyable evening of entertainment to relieve the tensions of the five-day technical program and schedule of committee meetings.

The local committee received praise for the arrangements made to make the meeting a success. The dinner and Pops concert were the pinnacle of the week. Other committees contributing substantially to the convenience and success of the meeting from the point of view of those attending were the Hospitality and Information Committee and the Transportation Committee which provided help and advice to those planning to spend additional time in and around Boston or visiting historic New England.

Arrangements were made also by the Entertainment Committee for those interested to visit laboratories and plants in the Boston area. More than 20 companies, government agencies, and educational institutions offered their facilities.

Ingenious instrumentation and rugged practical applications to research and testing were featured by manufacturers and distributors of apparatus and instruments at the Society's 13th biennial exhibit. A wide range of items from small, hand-manipulated instruments and electronic control devices through high-temperature ovens and heating elements to giant universal testing machines were displayed by 66 different concerns occupying an exhibit area of over 16,000 square feet. The exhibit also was the largest ever held by the Society.

The photographic exhibit and competition also was the largest ever held by the Society. There was a total of 227 entries, including 182 prints on regular mounts, 40 transparencies, and 5 special scenic prints of New England. All of the metallurgical entries stressed the educational and useful technical value of the prints. Numerous photomicrographs, electron micrographs and photomacrographs showed attractive patterns and composition even to the nontechnical viewer.

Professor Kenneth B. Woods, head, School of Civil Engineering, and director, Joint Highway Research Project, Purdue University, was elected president of the society for a one-year term.

A. Allan Bates, vice president of research and development, Portland Cement Association, was elected vice president for a two-year term.

Frank L. LaQue, vice president and manager, Development and Research Div., The International Nickel Co., Inc., continues in the office of vice president to which he was elected last year.

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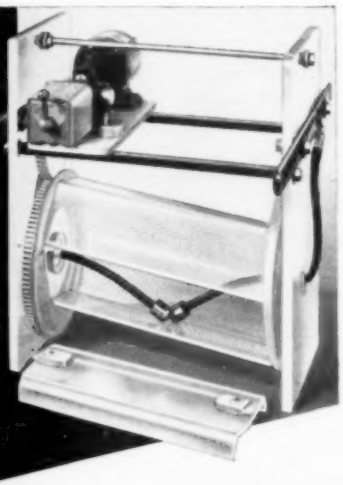

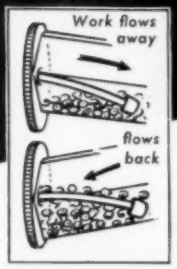

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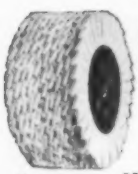
United States Patent No.

2,724,937

issued November 29, 1955 to George R. Churchill relates to the cloth-covered, cord sisal buffing wheel **exclusively manufactured** by Geo. R. Churchill Co., Inc. of Hingham, Massachusetts, and marketed under its trade mark "Finger-Buffs"* Reg. U.S. Pat. Off.

Geo. R. Churchill Co., Inc. intends to protect all its rights granted by this patent.

• *Churchill Finger-Buffs* are made from sisal or cloth; always bias-cut and top grade material; in all sizes from 3" to 21" diameters.*



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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,829,059, 4/1/58—Electroless Chromium Plating—P. Eisenberg and D. Raleigh, assignors to Sylvania Electric Company, Massachusetts.

Incorrectly reported as No. 2,828,059, page 770 of July PLATING, this electroless chromium plating solution consists of hypophosphite, 10 g/l, chromic salt, 17 g/l, a buffering agent and a chromium deposition rate controlling agent capable of reducing Cr^{+++} to Cr^{++} (oxalates). Example 1 is in error, so Example 2 is herewith given:

$CrBr_3 9H_2O$	16 g/l
$CrI_3 9H_2O$	1 g/l
Sodium Citrate	10 g/l
Sodium hypophosphite	10 g/l
Sodium binoxalate	9 g/l

The bath is operated at 75–90C at a *p*H of 8 to 10.

11 claims.

No. 2,832,706, 4/29/58—Phosphating Composition—B. Toubes, assignor to Victor Chemical Works, Ill.

A composition for cleaning and treating metal consists of 70 to 85 per cent of an alkali metal phosphate, about 5 to 20 per cent of an alkali oxalate and a minor proportion of an acid stable organic wetting agent.

7 claims.

No. 2,832,707, 4/29/58—Treatment of Iron—F. Rosstentscher, assignor to Farbwerke A., Frankfort am Main, Germany.

Expose the steel article in a solution containing 7 to 15 g/l of an alkali metal chlorate, 5 to 25 g/l of an oxalate and 5 to 60 g/l of phosphoric acid (meta, ortho, pyro, or poly and salts).

9 claims.

No. 2,832,708, 4/29/58—Treating Stainless Steel—E. Karchner, assignor to General Motors Corp., Detroit, Mich.

A solution for treating stainless steel consists of 3 to 10 per cent of chromic acid and 2 to 5 per cent of commercial orthophosphoric acid. Operate at 170–190 F and immerse for 10 min.

8 claims.

No. 2,832,729, 4/29/58—Electrodeposition of Fe-Zn Alloys—Wm. H. Safranek, assignor to Rockwell Spring and Axel Co., Coraopolis, Pa.

A leveling ductile Fe-Zn alloy is claimed from an aqueous acidic solution containing ferrous ion in the amount of 20 to 100 g/l and zinc ion in the amount of 0.004 to 0.05 g/l. The temperature is given as 100 to 220 F and the *p*H as 1.5 to 3.5.

6 claims.

No. 2,833,637, 5/6/58—Buffing Wheel—H. Zucker and W. Wilkinson, assignors to Hanson-Van Winkle-Munning Co., Matawan, N. J.

A buffing wheel impregnant is described as containing "a non-drying fatty acid as an essential constituent." Another claim describes the use of a fatty acid and a fatty acid ester wax.

5 claims.

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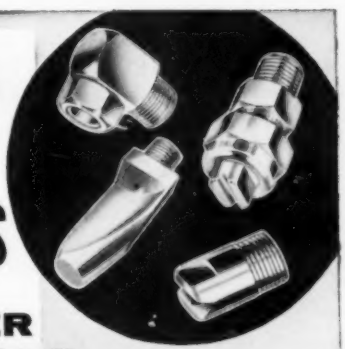

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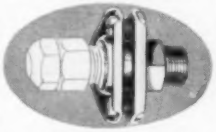

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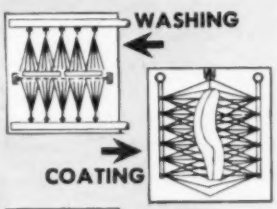

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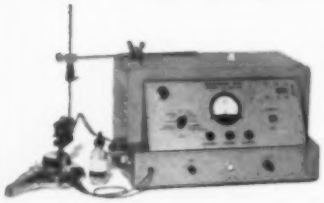

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No. 2,833,676, 5/6/58—Metal Coated Dielectrics—J. Heibel and J. Schell, assignors to Erie Resistor Corp., Erie, Pa.

Claim 1 states: "In the method of gas plating copper coatings on the surface of titanate ceramic dielectrics by flowing into contact with the heated surface of the ceramic a mixture of inert gas and carbureted vapor of a copper compound having the property of vaporizing at a temperature below that at which it decomposes by pyrolysis, the improvement which consists in first freeing the ceramic surface of adsorbed oxygen by substitution of adsorbed inert gas for the adsorbed oxygen prior to flowing the mixture into contact with the surface whereby the pyrolysis of the copper compound takes place on an oxygen free surface and the resultant copper coating has low resistance characteristic of pure copper rather than high resistance characteristic of a copper coating having codeposited oxides.

4 claims, 4 figures.

No. 2,833,679, 5/6/58—Coating Aluminum—M. Steinberg, assignor to Horizons, Inc., Princeton, N. J.

A flux cover for a molten metal for coating aluminum and alloys thereof with a metal more base than aluminum consists of 52 to 82 mol per cent of aluminum chloride and 18 to 48 mol per cent of at least one alkali selected from sodium, potassium and lethium fluoride.

3 claims.

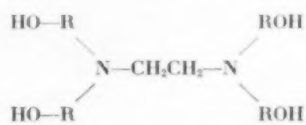
No. 2,833,703, 5/6/58—Removing Chromium from Plating Baths—E. Raue, assignor to MacDermid, Inc., Waterbury, Conn.

To remove chromic ion as a contaminant of metal cyanide plating baths add a substituted anthraquinone capable of forming a chromium lake, then treat with activated carbon.

16 claims.

No. 2,833,705, 5/6/58—Cadmium Plating—John Winters, Westlake, Ohio.

The use of a totally hydroxyalkylated ethylene diamine of the formula



where R is an alkyl radical of 2 to 4 carbons, is claimed as a cadmium plating addition agent. The concentration is given as 0.1 to 1.0 g/l N, N, N′, N′,-tetrakis ethylene diamine is specifically named.

21 claims.

No. 2,833,708, 5/6/58—Electroplating Apparatus—M. Hammond and Glade Bowman, assignors to Rockwell Spring and Axle Co., Coraopolis, Pa.

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Claim 1 states: "Apparatus for electroplating a three-dimensional article having convex surfaces comprising a tank for fluid in which the article is to be immersed, a member thereon adapted to suspend the article in the fluid and having means for conducting current therefrom, rows of elongated electrodes, defining an unobstructed open space in the tank, spaced apart means for moving the member and the suspended article through a curved path oscillating so as to weave between the electrode rows to continually reverse direction with respect thereto and to the length of the tank to constantly change the distance between the article and the electrodes, said member having opposite end structures disposed one over each of said means, connections supporting each end structure with a rotating fit upon the means at that end for motion in a path closing on itself, and thrust delivery means for applying thrust to shiftably operate said spaced apart means for moving the member and the suspended article in reciprocatory motion in a direction perpendicular to the plane of rotation aforesaid, said means constituting the sole means of support of said member.

9 claims.

No. 2,833,710, 5/6/58—Electrode Assembly—Dorothy Mielke, Indianapolis, Ind.

The single claim states: "An electrode structure comprising an elongated electrode body, a support hook detachably secured at one end of said body, an elastic sleeve tightly engaging a portion of said hook, said sleeve having a skirt portion defined by a laterally extending portion with a depending peripheral portion tightly engaging the upper end of said electrode, the wall thickness of the entire skirt portion being uniform and substantially less than the wall thickness of the remainder of said sleeve.

No. 2,834,359, 5/13/58—Cleaning Apparatus—J. Kearney, assignor to Detrex Chemical Industries, Detroit, Mich.

A chlorinated solvent degreaser particularly useful for small parts and with an improved means for denuding the solvent is described. Reference is made to patent No. 2,802,476.

3 claims, 8 figures.

No. 2,834,659, 5/13/58—Chemical Polishing of Metals—O. Mathre and D. Sowards, assignors to E. I. duPont de Nemours and Co., Wilmington, Del.

A metal polishing solution is claimed containing 0.3 to 5.4 per cent of monoperphosphoric acid, 70 to 80 per cent phosphoric acid and 15 to 25 per cent water. The water is especially good for copper, aluminum and alloys thereof and is operated at 90 to 130 C.

8 claims.

No. 2,834,690, 5/13/58—Producing Shapes by Gas Plating—P. Marvin, assignor to The Commonwealth Engineering Co., Dayton, Ohio.

The method consists of building up a thick coating of metal from a decomposable metal compound on a cellulosic shape. The cellulose backing is then burned away. Tungsten and molybdenum specially noted in the disclosure.

2 claims, 6 figures.

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EXCEPTIONAL THROWING POWER!

CuSOL*

SEYMOUR'S NEW Copper Plating Process!

**Patent Applied For*

Yes, throwing power enough to plate **through** holes in printed circuits, for instance. *Plus* all these advantages of CuSOL . . . .

- Eliminates "treeing" and nodular buildup
- Add directly to either Copper Sulphate or Copper Fluoborate baths
- Copper plate is hard (75/Rock. F)
- Permits use of wide current density range
- Increases plating speeds from 50% to 200%
- Smoother, more ductile deposits of any thickness than is possible with molasses, bone glue or dextrin baths
- Inexpensive to use, economical to maintain

COMPARE!	CuSOL	Dextrin Type Baths
Tensile Strength	41,000 psi	33,000 psi
Elongation in 2 in.	23%	16%
Rockwell "F" Scale	75	66
Ductility	4 bends on itself	2 bends on itself

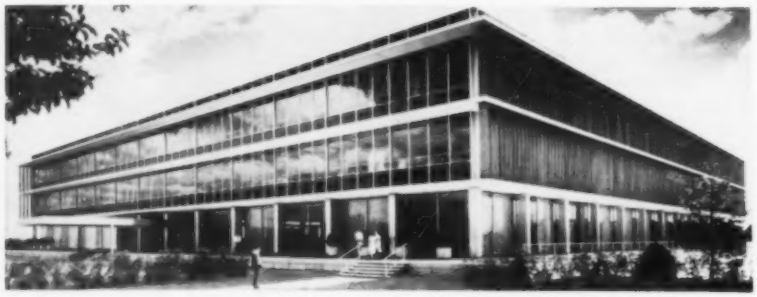
(Thickness of copper specimens tested was 0.033")

Write for CuSOL TECHNICAL BROCHURE

ELECTRO CHEMICAL SUPPLIES DIVISION **THE SEYMOUR MANUFACTURING COMPANY**

5 FRANKLIN ST., SEYMOUR, CONNECTICUT

INDUSTRY NEWS



The new aluminum office building of Reynolds Metals at Richmond

REYNOLDS METALS OPENING NEW OFFICE BUILDING

A new multi-million dollar office building will be formally opened at Richmond, Va. this month as the new home of Reynolds Metals Co.

The building contains 1,235,000 pounds of aluminum, used in many ways for economy, efficiency or beauty.

Aluminum uses include the world's largest system of automatic sun louvers, movable office partitions, acoustical and light-diffusing ceilings, a new line of aluminum office furniture, aluminum yarn draperies and carpeting, and most of the hardware.

From the exterior, almost everything that can be seen is either aluminum or glass.

The square-shaped, four-level structure is capable of housing 1,000 employes, contains 293,673 square feet of usable floor space and dominates 160 acres.

Through the glass walls—tinted gray to resist glare—employes can look out on a 253-foot reflecting pool.

The building cost $11.5 million, excluding land and land improvements.

A system of 880 giant color-anodized aluminum sun louvers, each 14 feet high and 22 inches wide, shield the eastern and western faces of the building from heat and glare and reduce air conditioning load. The louvers are geared to an astronomical clock which will anticipate the movements of the sun through the year 2100 AD.

Other exterior uses of aluminum include the vertical mullions, black anodized spandrels between floors, column casements, the entrance canopy, door frames and other trim.

The landscaping project, one of the largest in Virginia history and second in size only to Colonial Williamsburg, involved planting more than 4,000 trees and shrubs and 10,000 flowers, plus installation of an aluminum irrigation system.

Completion of the building is the latest high point in the Reynolds aluminum story, which began only 39 years ago when the late R. S. Reynolds organized the parent United States Foil Co. to manufacture foil for tobacco and cigarette packaging.

In 1928 Mr. Reynolds founded the present Reynolds Metals Co. to handle the aluminum operations among his expanding interests. The company began primary production of aluminum in 1941, just in time to make a contribution to the war effort.

NARDA ULTRASONICS ACQUIRES LARGE PROPERTY

The Narda Ultrasonics Corporation, Mineola, L. I., N. Y., has just acquired a modern one-story, attractively landscaped building at 625 Main Street, Westbury, L. I., N. Y. The new facility will provide the company with 16,500 sq ft of additional production space, and an equal amount of land for employe car parking.

Sales, administration, and other management functions of the company will remain at 118-160 Herricks Road, Mineola. The Westbury plant will house all production and assembly operations, research and development laboratories, machine shops, the mechanical erection department, the customer applications laboratory, and the physical and chemical process division.

PENNSALT ESTABLISHES NEW SALES OFFICE

Pennsalt Chemicals Corp. announces the establishment of a new sales office for its corrosion engineering products in the Kansas City, Mo. area under the management of Edward H. Garnett of the Shutt Process Equipment Corp.

Mr. Garnett is a well-known figure in the industrial sections of western Missouri, eastern Kansas, and northeastern Oklahoma, which he will serve out of his headquarters at 6317 Raytown Road, Kansas City. He has been engaged in the sale of industrial corrosion specialties in this region for more than 11 years.

The red brick and steel frame structure is similar architecturally to other sales development laboratories on the Chestnut Run site.

GRAVER WATER HAS FOREIGN OPERATIONS DEPARTMENT

Graver Water Conditioning Co., New York, division of Union Tank Car Company, has formed a new foreign operations department. Jesse D. Crell has been appointed manager. The new unit will work in conjunction with the International Division of Graver Tank & Mfg. Co., Inc., a subsidiary of Union Tank.

The function of the department will be to expand the world-wide organization of representatives handling the complete line of liquid treatment equipment designed and manufactured by Graver Water Conditioning Co.

Expansion of foreign operations for the present will be made with particular emphasis on Central and South America. As part of its program, the department will establish additional sales agencies, foreign licensing agreements and, where practical, foreign fabrication facilities.

ALLIED RESEARCH OFFICERS ANNOUNCED

Allied Research Products, Inc., has announced the following officers and directors as a result of the merger of Wagner Brothers and Allied Research, which occurred May 1, 1958.

The officers include H. C. Irvin, president; Jules Horelick, vice president; Philip G. Richey, vice president and treasurer; J. A. Cairns, vice president; F. M. Mansfield, vice president; Harry C. Quast, secretary and Joseph W. Agerson, assistant secretary.

Directors are H. C. Irvin, chairman, Joseph R. Wagner, Philip G. Richey, J. A. Cairns, John C. Corkrin, Harry C. Quast, Charles W. Ostrander and Jules Horelick.

The operational structure includes Mr. Wagner as administrative assistant to Mr. Irvin and Bruno Leonelli as technical assistant. Mr. Cairns is vice president in charge of sales, Mr. Mansfield vice presi-

Speed

Diamond CPA 1800 speeds up chrome-plating time!

DIAMOND CPA 1800 is *the additive* for chrome plating which expands tank capacity, improves throwing power and the metallurgical character of chrome plate. It's the modern teammate of DIAMOND CHROMIC ACID!

And, when you order your chromic acid from Diamond, you get the latest facts on *all* phases of chromic acid application, research and testing. Facts that can help you lick a production problem, quality problem, or research problem.

So, call your Diamond Representative, or your nearby Diamond Distributor, now. They can help you get quality chrome-plating jobs *every time*, based on our broad experience with plating. DIAMOND CHROMIC ACID is available where and when you need it. DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

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VITREOSIL®

FUSED QUARTZ IMMERSION HEATERS
With Interchangeable Parts

RESISTANT TO
- CORROSION
- THERMAL SHOCK
- HIGH TEMPERATURE

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Compact, safe and efficient, *Vitreosil*® electric immersion heaters offer you your most dependable units. Designed for acid pickling and electroplating solutions and other acid baths, *Vitreosil* heaters give greater heat transfer per unit area and greater resistance to chemical attack.

Vitreosil immersion heaters are made of pure fused silica and have special corrosion-resistant caps, built-in ground wires for additional protection for maximum industrial efficiency. Write today for our bulletin and prices.

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dent in charge of marketing, Mr. Richey vice president in charge of finance and Mr. Horelick vice president in charge of development.

In making these announcements, Mr. Irvin reiterated that all metal finishing operational assets and products of Wagner Brothers have been acquired by Allied Research. Wagner Brothers Inc., will continue to exist as an entity, but will neither manufacture nor market any product for the metal finishing industry.

Mr. Cairns has announced that allied Research will represent Cowles Chemical Co. coast to coast for its complete line of cleaners for metal finishing.

H-VW-M DIVERSIFIES TO BROADEN MARKET

Hanson-Van Winkle-Munning Company has announced an intense development program intended to broaden the company's market for rectifiers.

The company continues to specialize in low-voltage rectifiers for the electroplating industry. Now its rectifier department is reorganized and expanded to develop equipment for electrochemical and electrometallurgical processing, utility power conversion, shop power supply, special laboratory supply, motor generator field excitation, high-voltage hard anodizing and miscellaneous other industrial dc applications.

Back of the new developments in rectifiers is H-VW-M's recently accelerated research and development program. The company recently completed building, staffing and equipping an electrical laboratory largely devoted to new developments in rectifiers.

H-VW-M introduced in 1876 what the company claimed was the first practical electroplating dynamo. The dynamo won a gold medal two years later at the Paris Exhibition. The company first produced rectifiers in 1924 and has marketed models with copper oxide, selenium and germanium diodes over the years. Now they will offer, in addition, rectifiers with silicon diodes.

DeVILBISS FORMS NEW SUBSIDIARY

Additional facilities to provide finishing systems to industry are now offered by The DeVilbiss Co. through a new wholly owned subsidiary, DeVilbiss Metal Fabricators Co., Detroit.

The new firm is the result of the consolidation of the Peters-Dalton Division of Detroit Harvester Co. and Newcomb-DeVilbiss Co.

As a result of the consolidation, DeVilbiss is able to offer manufacturing, engineering, sales and service for a complete finishing department or any part thereof.

Reber C. Stupp, formerly general manager of Peters-Dalton, has been named vice president and general manager of the new company. J. W. Cornelius, former head of engineering for Newcomb-DeVilbiss, vice president-engineering and T. Kenneth McGuire, former sales head for Peters-Dalton, vice president-sales.

Headquarters of DeVilbiss Metal Fabricators will be maintained at 17900 Ryan Road, Detroit, and manufacturing facilities will be utilized at both the Ryan Road address and in the former Newcomb-DeVilbiss plant at 5741 Russell Street, Detroit. Headquarters of the parent company are in Toledo, Ohio.

CARBORUNDUM TO BUILD NEW PLANT

The Carborundum Company's board of directors has authorized new plant facilities in Niagara Falls, estimated to cost approximately $6,000,000, according to an announcement by General Clinton F. Robinson, president of the company.

The new plant will incorporate the results of over 2 years of engineering development. Although the plant will not be fully automatic, it will feature important specially designed automatic and semi-automatic equipment.

ACOUSTICA ASSOCIATES ACQUIRES GENERAL ULTRASONICS

Acoustica Associates, Inc. and The General Ultrasonics Co., two manufacturers of ultrasonic equipment have joined forces.

Acoustica acquired General by issuing 25,872 shares of their common stock to General's stockholders.

The General Ultrasonic Company will be operated as a wholly-owned subsidiary of Acoustica with Stanley R. Rich continuing as president of General.

The total staff of the two merged companies exceeds 250 in seven plants located in Mineola, Long Island, N. Y., Hartford, Conn., and Culver City, Calif., and employment is planned to increase to 400 by the end of this year.

CRO-PLATE MANUFACTURING RIGHTS ACQUIRED BY PRESSURE BLAST

Pressure Blast Manufacturing Co., Inc. of 27 Pleasant Street, Manchester, Conn., has acquired assets and manufacturing rights of the former Cro-Plate Co. of Hartford, Conn. The entire line of Pressure Blast wet blasting equipment and abrasives is being continued. Manufacturing and sales offices have been relocated at the Manchester address. The equipment and abrasives continue to be distributed by plating and polishing houses throughout the country and Canada.

INDUSTRY NEWS BRIEFS

FOREIGN TECHNICAL INFORMATION CENTER

Secretary of Commerce Sinclair Weeks has announced a Foreign Technical Information Center in the U. S. Department of Commerce to provide American science and industry with access to translations of a large amount of Soviet technical information.

The Center is a part of the Office of Technical Services, Business and Defense Services Administration, with John C. Green as director of OTS.

The services of the Foreign Technical Information Center include publication of abstracts of all articles appearing in 141 Soviet technical journals, translations of important sections of *Referativnyy Zhurnal* (the Russians' own abstract journal), and a semi-monthly review of various areas of Soviet science compiled by the Central Intelligence Agency.

OTS will soon begin distributing complete translations of articles and books. Translations will be listed in an abstract journal to begin publication about September.

NEW ZINC QUARTERLY

The American Zinc Institute has just published the first issue of its new quarterly newsletter entitled "The Zinc Spotlight."

The Zinc Spotlight is designed to keep readers abreast of new product research, design developments, production improvements, and application and market trends related to zinc and zinc-base products.

A quarterly, The Zinc Spotlight may be obtained free of charge by writing American Zinc Institute, Inc., 60 East 42nd Street, New York 17, N. Y.

MINES BUREAU COPPER RESEARCH

Bureau of Mines research on copper during the fiscal year that began July 1 will seek increased metal recovery and reduced production costs through improved technology as well as economic methods for developing large sub-marginal reserves, the Bureau has announced.

Metallurgical studies will emphasize an investigation of the feasibility of recovering copper from reverberatory-smelter slags. These slags are not only a potential source of additional copper but may also yield iron that can be used to precipitate copper in leaching.

Other metallurgical research to be conducted by the Bureau includes laboratory studies of the effects of ultrasonic waves of various frequencies and intensities on the electrodeposition of copper and its purity.

INTERNATIONAL ALUMINA FIRM

A new international corporation has been formed to develop vast bauxite deposits in French Guinea (French West Africa) and to produce alumina.

Known as FRIA Compagnie Internationale pour la Production de l'Alumine, the new corporation involves:

1. An estimated total cost of $135,000,000.
2. Participation by five corporations from four nations of the free world
3. Plans to build the world's largest alumina plant in French Guinea.
4. Development of one of the world's largest known bauxite deposits.

Representing one of the largest international efforts for the development of a metals raw material in an underdeveloped industrial area, the FRIA group consists of Olin Mathieson Chemical Corp., two French companies, Pechiney Compagnie de Produits Chimiques et Electrometallurgiques and Societe d'Electrochimie, d'Electrometallurgie et des Acieries Electriques d'Ugine; Aluminum Industrie Aktiengesellschaft of Zurich, Switzerland; and The British Aluminum Company Ltd.

Nickel Plating Calculations

●

Barrel nickel plating is an efficient operation. The nickel plating solution is almost 100% efficient. Accordingly the calculations in thickness and coverage are quite simple. One basic calculation for rough cost purposes is that 400 ampere hours takes one pound of nickel off the anodes and puts one pound of nickel on the work.

●

In calculating thickness of plate it is of course necessary to know the area of the load. There are several ways of calculating this such as tables of areas per pound for sheet metal, tables of areas for threaded parts and other areas. Also if the thickness of some particular area is desired it is necessary to know the plate distribution. Within normal error the plate distribution is the same for still tanks and barrels. Then the average amperes drawn on that size load must be known. Normally the contents need not be figured in the load area unless they are quite large. From these figures the average current density can be calculated. The thickness of plate can be calculated from the following.

●

1.9 amperes per sq. ft. for ½ hour gives 0.00005 inches of nickel. This is used in simple ratio with your own figures.

●

When you encounter a part where a definite thickness of nickel is required the amount of nickel required may be calculated from the factor. 1 oz. of nickel covers 2.7 sq. ft. to a thickness of 0.0005 inches. In calculating with this factor allowance should be made for the plate distribution.

●

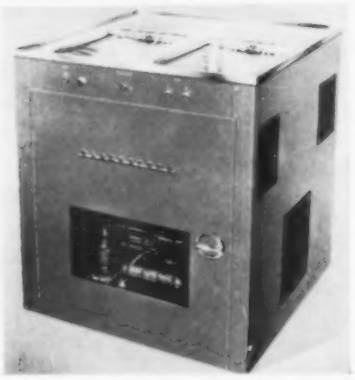
Of course your customers want quality work as well as adequate thickness. If good barrel nickel plating is your objective there's no better way than by using True Brite Nickel Brightener designed especially for barrel nickel plating.

TRUE BRITE CHEMICAL PRODUCTS CO.
98 FALLS AVENUE OAKVILLE, CONN.

USE READER SERVICE CARD; INDICATE A 953.

EQUIPMENT AND SUPPLIES

Use the convenient Reader Service Card to obtain additional information on any of these items



E—901. Ultrasonic Cleaner—The Blackstone Corp. has introduced new ultrasonic cleaning equipment for the precision cleaning of parts and assemblies.

The unit has two 10 in. by 14 in. by 10 in. deep stainless steel tanks for ultrasonic cleaning and rinsing. The solution in each tank is continuously circulated and filtered to remove all particles of 2-5 micron size or larger. Each tank is activated by multi-element magnetostrictive transducers operating at approximately 20 KC/sec.

Other ultrasonic cleaning equipment is available in a large variety of sizes. The same basic unit is available with either single or multiple tanks which fit into the 25 in. by 25 in. stainless steel cabinet top.

E—902. Plastic Gloves—New plastic gloves, rugged enough to be re-usable and inexpensive enough to be disposable, are announced for industrial use by Plastic-smith, Inc. The gloves, available in large, medium, and small sizes, are packaged in convenient rolls of 12 to 1000.

Known as Handgards, the gloves for industrial use are made of 1-¾ mil polyethylene material and are pre-talcumed for ease in sliding on and off. They have the advantages of polyethylene, such as resistance to acids, dyes, solvents, and most chemicals.

Ventilation is improved over tight-fitting gloves by their being flared at the wrist, and yet can easily be sealed with a rubber band when the hands need to be immersed.

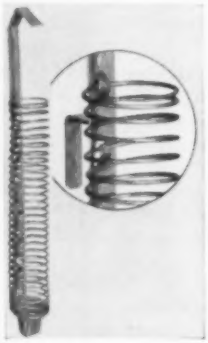
E—903. Plating Process—Development of a new plating process, capable of depositing a quality metallic plate on non-conductors like paper, ceramics, and fibers with a plating speed of up to 13 lb of deposited metal per hour, is announced by The Commonwealth Engineering Co.

Requiring no electrolytes or electrodes, and able to apply different alloys simultaneously, the new plating process is said to function with any metallic compound that can be vaporized.

Applied in gaseous form, the plating material is circulated about the workpiece, being deposited evenly on selected flat surfaces, bores or intricate shapes.

E—904. Weldless Anode Baskets—Resistance to the many new solutions that eat the welds of conventional welded anode baskets is provided by a new weldless anode basket introduced by Belke Manufacturing Co.

The 2/32 in. by 1 in. cold rolled spine is formed at the bottom to hold the coil spring basket securely without welding. Die-formed tongues from the spine also engage coils of the basket, thereby retaining the basket against the spine without welds.

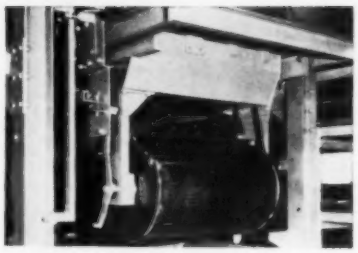


It is available with a special hook in the inset which is used to hold the basket high in order that the operator may see when more anodes are needed or furnished curved to specifications.

Standard length, hook to basket is 6 in. Standard basket lengths are 18, 21, 24, 27, and 33 in.

E—905. Plating Generator Brush—Another step in correlating longest brush life with highest degree of commutating ability and the elimination of commutator spots has been achieved by a new generator brush recently announced by Carbon Products Division, Speer Carbon Co.

The new brush, Grade 683/7802, is an improved grade designed specifically for low-voltage plating generators up to 12 v. Development tests and full-scale production use reportedly prove it to be superior for this class of service.



E—906. Processing Barrel—A horizontal door that opens and closes fully automatically is a feature of a new metal processing barrel introduced by Hanson-Van Winkle-Munning Co.

The barrel is designed for cleaning, phosphating, blackening, Lubrite, Bonderizing, chromate treatments, pickling and similar processing.

After the barrel is loaded, a signal starts it rotating. Rotation actuates the mechanism that closes the door, which is held secure by a detent spring while the barrel passes through the treatment cycle. On completion of the treatment, barrel rotation is reversed to open the door and discharge the load.

Because of its automatic features, the barrel lends itself to integration into automated processes. It is adaptable to automatic hopper feeding and automatic unloading to hoppers or conveyor belts.

E—907. Buff Flexibility Process—A new "soft" treatment has been perfected by American Buff Co. This development lubricates and softens cotton or sisal buffs, producing a flexible texture which readily penetrates crevices, recesses and grooves, and uniformly follows every contour for faster, thorough finishing.

Because it efficiently impregnates all buff fibres and requires fewer passes to complete a job, this treatment is said to add extra wear to any type of buff.

E—908. Industrial Glove—Development of a new industrial glove that is said to be completely impervious to strong acids and solvents is announced by the Surety Rubber Co.

Fabricated from Dupont Teflon, and tested under the severest conditions, the gloves were unaffected by attacks of fuming red and white nitric acids, 100 per cent sulfuric acids and all strong solvents it is reported. They are available in 12 and 16 in. styles that feature the Surety turn cuff for maximum protection.

HERE'S YOUR REWARD

for telling us what <u>you</u> want in brighteners--

ISOBRITE™

PLATING BRIGHTENERS

Now—28 ISOBRITE BRIGHTENERS

For Zinc, Cadmium, Copper and White Brass

HAVE THE *FOUR* BIG FEATURES YOU ASKED FOR!

When the Allied line of brighteners, now known as ISOBRITE, had the famous ARP trademark on them, we made a survey to find out exactly what *you* wanted most in brighteners. Your answers helped guide our research and development staff in evaluating and consolidating our new line.

Now, here are the results—the industry's most complete line—28 *ISOBRITE Brighteners with these most-wanted features:*

1. LONGER LIFE

Your own records will show ISOBRITE Brighteners give longest possible life in rack or barrel plating operations.

2. BRIGHTNESS

You'll see for yourself that ISOBRITE Brighteners give a diamond-like sparkle that just can't be matched.

3. THROWING POWER

Even if your product has deep recesses, you'll get a uniform, all-over brightness that only ISOBRITE Brighteners can give you.

4. WIDER BRIGHT RANGE

ISOBRITE Brighteners operate efficiently over exceptionally wide current density ranges and have greater tolerance for temperature change.

Remember, there's an ISOBRITE Brightener especially designed for your specific operations—whether you're rack or barrel plating zinc, cadmium, copper or white brass . . . an ISOBRITE Brightener that is entirely compatible with most other brighteners. Don't just order brighteners—specify ISOBRITE. There *is* a difference!

Your Allied Finishing Systems Engineer will be glad to discuss the benefits of ISOBRITE Brighteners in your operations. He's listed in your 'phone book under "Plating Supplies". Or, write for technical data and product list giving details of your operations.

Allied Research Products, Inc.

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BRANCH OFFICE: 400 MIDLAND AVE., DETROIT 3, MICH.

Chemical and Electrochemical Processes, Anodes, Rectifiers, Equipment and Supplies For Metal Finishing

E—909. Turning Head—To simplify Dalic plating of circular or cylindrical components, Marlane Development Co. and other Dalic process distributors are marketing a special low-speed turning head as an optional accessory.

The turning head includes a variable speed control, for infinite adjustment of rotation from zero to 400 rpm, in either direction. The range of speeds has been selected to handle well over 90 per cent of the work normally plated by the Dalic method.

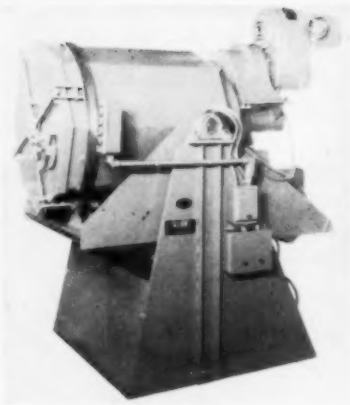
Overloading the turning head is almost impossible, because the only restraining force on the shaft is the friction between the cotton-wrapped stylus anode and the workpiece. However, to guard the speed reducer in case the chuck is rotated by hand for positioning, automatic torque overload protection is also included.

E—910. Aluminum Cleaner—Alkalume D.S., a new chemical product specially prepared for de-smutting aluminum is now being offered by the Northwest Chemical Co.

Designed to replace dangerous liquid acids, it is claimed to have a longer life than sulphuric-chromic and to produce a bath that cannot be achieved with liquid products. De-smutting time is equivalent to that of liquid acids—approximately one-half of etching time, according to the manufacturer.

The new de-smutter is dry, dustless, and free-flowing.

It is available in 500 lb drums and 150 lb kegs. When adding Alkalume D.S. to water or bath, no heat reaction is produced and no special equipment is needed, it is reported.



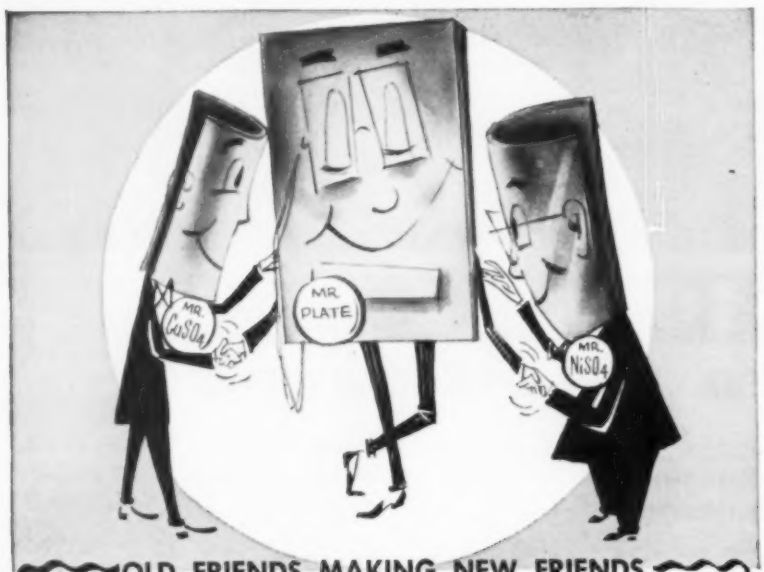
E—911. Barrel Finisher—Globe Division of Casalbi Co. has announced a horizontal power tilt barrel finishing machine. The Model 30-34 is a heavy duty finishing machine for grinding and burnishing parts. Total load is 1500 to 2000 lb. Typical parts are those which lend themselves to self-tumbling, i.e., parts which can be finished without the aid of separate media. Abrasive compound and water is used for grinding, then burnishing compound and water for burnishing.

The barrel is self-aligning. It is bolted to large spur gear which is supported by two tapered bearings. The gear, bearings, bearing housing, motor and motor pinion are all one integral unit, free to align itself with the barrel in both the vertical and horizontal direction.

The machine is a welded fabrication of heavy structural and plate steel. The drive motor is 3 hp gear head type with variable or single speed.

E—912. Acrylic Solution—A new acrylic polymer solution has recently been developed for the coatings industry by Rohm and Haas Co. Acryloid B-44 is now available in commercial quantities as a 40 per cent solution in toluol. This newest of the Acryloid resins is said to be particularly noteworthy for the hardness and adhesion of its films. Fast solvent release and excellent pigment dispersion permit the formulation of this solution in coatings with as high as 45/55 pigment-to-binder ratio, yet with retention of good gloss, it is reported.

Because coatings based on this product have very high adhesion to metal surfaces and organic materials, such finishes are excellent for coating plain and vacuum-metallized plastics, for top-coating primers, as a recoating binder for automotive enamels and lacquers, as well as a clear or pigmented lacquer on aluminum, plated metals, or furnishings, according to the manufacturer.



OLD FRIENDS MAKING NEW FRIENDS.

Copper and Nickel have been brought up together in the plating field. They plate, deposit, and alloy together—they are OLD FRIENDS.

TRIANGLE BRAND COPPER SULFATE and TRIANGLE BRAND NICKEL SULFATE as principal sources of copper and nickel in the plating field, are making NEW FRIENDS every day.

The reasons are obvious — purity, solubility, uniformity and high conductivity of their solutions result in QUALITY PLATING.

All-important "extras" found in the use of Triangle Brand Copper and Nickel Sulfates yield long-life plating performance that MAKES THE DIFFERENCE.

Specify: Triangle Brand Copper Sulfate and Triangle Brand Nickel Sulfate for dependable plating baths.

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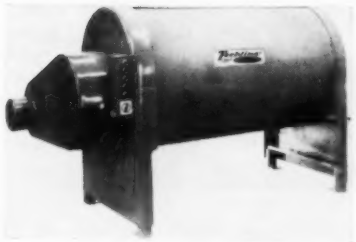


E—913. Barrel Finishers—Vibration-free operation is claimed for a new line of precision barrel finishing equipment known as the Model 30 series manufactured by the Techline Division of Wheelabrator Corp.

Other features of the series include molded fiberglass safety gate which is said to be corrosion-proof and lightweight for easy operation; full-opening doors on the cylinder for greater convenience in loading unloading and cleaning the cylinder; doors sealed by special cam locks which operate on only 90 degree of turn, exerting high-compression pressure on the Neoprene door seals.

Power transmission is by a V-belt drive which reportedly is noiseless, reduces maintenance problems and wears longer than a chain-and-sprocket drive. The equipment also features safety controls to prevent the machine from operating with the gate open except for "jogging" and a fiberglass housing which guards the entire drive mechanism.

These barrel finishing machines are offered in 20 models ranging from 5 to 30 cu ft capacity and having one to six separate compartments, designed for both wet and dry processes.

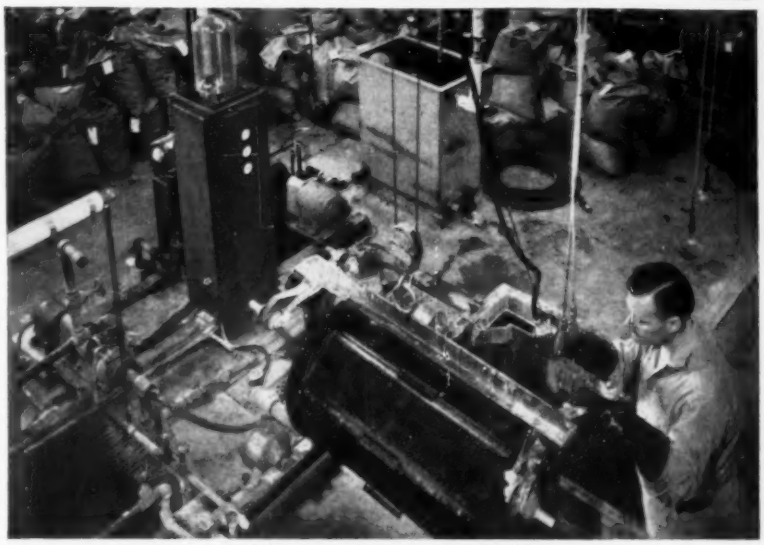
E—914. Cyanide Copper—A new cyanide copper plating process, recently developed by Rohco Research, has been announced by R. O. Hull & Co., Inc.

According to the manufacturer, the new Ro-Bright process produces extremely wide and usable production bright plating range through current densities up to 80 amp/sq ft with good results obtainable with either direct, interrupted, or periodic reverse current. Outstanding uniformity between high and low current density areas permits shorter plating time and eliminates excessive build-up on high current density areas to achieve minimum thickness of deposit in recesses, thus saving time and metal it is reported. The process may be used with potassium, sodium, or mixed formulation to produce semi-bright or full-bright copper, as desired. It may be used with or without Rochelle Salts. There are three addition agents: a wetting agent, a primary brightener, and a secondary brightener to cover all applications for semi-bright to full-bright deposition.

E—915. Flux Remover—A recently developed product, Bernite 45, will effectively and rapidly solve all flux removal problems, according to its producer, Bernard Chemical Products Co. It is very effective in removing flux residues as a result of brazing and silver or gold soldering. These flux residues are particularly tenacious when allowed to cool. However, this remover is said to dissolve them in a matter of minutes and pickle the metal as well. It is supplied in powder form using a concentration of 10 to 12 oz/gal of hot water. Bernite 45 is claimed to eliminate hazards, spillage, and toxicity factors which are frequently found with the use of acids.

E—916. Resin—Recently announced by National Aluminate Corp., Nalcite HCR-W is a new cation exchange resin said to have greater physical stability than has ever been attained in a cation exchanger. The almost colorless beads are reportedly free of internal stress and strain. Bead breakage is claimed to be virtually eliminated as well as the resin loss usually caused by broken beads.

Operating temperatures as high as 250F do not affect stability or capacity, according to the producer. In addition, company spokesmen expect it to be widely used in mixed bed demineralizers since its resistance to bead breakage is claimed to prevent fouling of the anion exchanger with fines from the cation material.



Cyanide waste treatment system in plating room of the Palnut Co., Mountainside, N. J.

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Wallace & Tiernan makes chlorinators and chemical feeders for use in any size plating plant—large or small. Learn all the advantages of treating plating waste with chlorination in Bulletin I-62, which gives full details about W&T Alkaline Chlorination.

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TRADE LITERATURE

L—901. Printed Circuits Plating—Solutions to the problem of the failure in service of plated printed circuits, are offered in a 4-page article co-authored by E. C. Rinker, vice president and technical director, Precious Metals Division, Sel-Rex Corp.

Starting with the specific application and intended service of the printed circuit, the article recommends ways and means to improve in-service reliability through latest developments in printed circuits plating technology. The precious metals, and various base metals, are covered in detail with their advantages and disadvantages for specific applications.

A table gives recommended thicknesses of electroplate of various base and precious metals, predicated by the application of the printed circuit.

Reprints of the article called IMPROVED BATHS SOLVE LIFTING OF PLATED CIRCUIT FOILS, may be had free of charge.

L—902. Buffing and Polishing Machinery—A four-page brochure describing "job-engineered" buffing and polishing machinery has been issued by the Divine Brothers Co.

The booklet contains a representative list of custom engineered finishing machines. Some are relatively simple in design, while others are extremely complex.

The machinery contained in the booklet is all job-engineered to specific problems.

Among some of the machines described are a Circuit Conveyor with head units, which can be utilized in a complete in-circle production line, or in a double production line with two operators; a Job-O-Matic Jr. work table with chain chuck and variable speed drive for use with various types of polishing; Model DLS abrasive belt head designed for polishing contours but equally effective with flat work; a single stage automatic buffing machine to handle round out-of-round reflectors, in addition to other odd shapes and contours.

L—903. Process Automation—A 12-page illustrated bulletin is available from Abbey Process Automation, Inc. Bulletin A.P.A. 101 contains photographs of the various parts of this automation system along with detailed captions.

The advantages, mechanical features, principles of controls and operation of controls are described. Data on transfer and loading frequency as well as cycle selection are given.

Schematic drawings and diagrams of the rack system, the barrel plating system, paint stripping system and molding system are included.

L—904. Airless Spray—Bede International Development Co. has issued a four-page brochure on their paint spraying equipment. Illustrated examples of the uses and application of the airless spray are included. Heat and pressure information are given. Photographs show how the equipment is specially adapted to individual country requirements. Among the industries listed as using the airless spray are automobile, machinery, aircraft, railroad, etc.

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L—905. Metal Cleaners—Data on their various cleaners is presented in a four-page, two-color booklet issued by Northwest Chemical Co. Immersion, electrolytic and spray cleaners for use prior to plating or organic finishing are listed according to the metal to be cleaned.

Recommendations for addition agents, drawing compounds and strippers are given.

L—906. Controlled Draft Water Heater—A four-page folder, 5210-A, has been made available by Sellers Engineering Co. describing the features of the Sellers controlled draft gas-fired water heater.

This new water heater, like all Sellers' heaters, is fired on the immersion heating principle. The gas is burned in a series of totally submerged long firing tubes—each provided with a separate burner at the firing end. The gas is literally "burned inside the water" for greater efficiency and a cleaner heater at all times. The firing tubes are of copper. The heater, available in a variety of sizes, is completely automatic with all needed controls and combustion safeguards.

L—907. Color Anodizing—How one machine anodizes automobile parts many different colors is described in an illustrated four-page leaflet, "One Machine Anodizes Many Colors," currently offered by Hanson-Van Winkle-Munning Co. It tells how Firestone Steel Products Co. finishes grilles and body trim for 1958 Fords at Akron, O., using a new H-V M-M anodizing machine.

A schematic drawing in two colors shows arrangement of treatment tanks in full detail, with tank design data listed in the legend. Text tells how racks are individually keyed so that work loads being treated simultaneously can be moved through varied cycles. Leaflet explains how this principle can be used to effect dollar savings. Details of chemistry and mechanics are given.

Five photographs illustrate the machine as a whole, loading, the rack keying mechanism in operation, warm rinsing, and solution agitation.

L—908. Sintered Metal Tumbling Media—These new metal tumbling media, produced by a sintering process on which patents are now pending, have been developed and are now being produced by Dixon Sintaloy, Inc., a subsidiary of the Joseph Dixon Crucible Co.

Offering advantages for deburring, cutting and burnishing, the new sintered media—now available in several desirable shapes—are said to exhibit up to ten times longer useful life than conventional tumbling media, as extensive tests show. They also permit simpler, standardized production of barrel finished parts.

In addition to uniformity, it is said these new tumbling shapes can be impregnated with auxiliary cutting, polishing or finishing compounds, and can be heat-treated as well. It is also said, they will not powder or break down in use, nor will they clog or lose their cutting characteristics with repeated use. Additionally, they can often be used dry without the usual tumbling solutions, and frequently the cleaning stages following tumbling can also be eliminated.

One of the advantages claimed of the new sintered metal media is the opportunity it offers for standardizing and simplifying production of barrel finished parts. Their exceptional durability eliminates the need to compensate for media breakdown and wear during runs, or with successive re-use.

Shapes that are now available include triangles, discs and spurs in a range of sizes in heat-treated steel and brass alloys suitable for use on a wide variety of parts and materials. They will appear on the market under the registered trade names of Sintabur, Sintabrite, Sintahone, Sintecut and Sintacote.

An illustrated, two-color bulletin describing the unique characteristics of the sintered media, and accompanying data sheets with information on applications, are now available.

L—909. Coatings—A new, four-page condensed catalog, detailing its complete line of corrosion-resistant fabrications and coatings, components, semi-finished materials, fabricating equipment, and laboratory ware, has just been published by the American Agile Corp.

The free literature contains more than 30 illustrations together with detailed specifications, design and operating features, and application information.

L—910. Vacuum Metallizing Coatings—A 16-page brochure titled "Vacuum Metallizing Coatings for Metal, Glass and Thermosetting Plastics" has just been published by the Bee Chemical Co. Various coating application procedures as well as the coatings used in conjunction with vacuum metallizing are described. Copies are available on request.

L—911. Hard Coat Aluminum Anodizing—An improved process for hard coat anodizing of aluminum is described in a bulletin just released by the Accurate Anodizing Corp.

Called the Porace process, and covered by patents pending, it is claimed to make possible a more uniform aluminum oxide coating and substantially greater thickness of the deposit, when desired.

A new bulletin describing the Porace hard coat aluminizing process is available.

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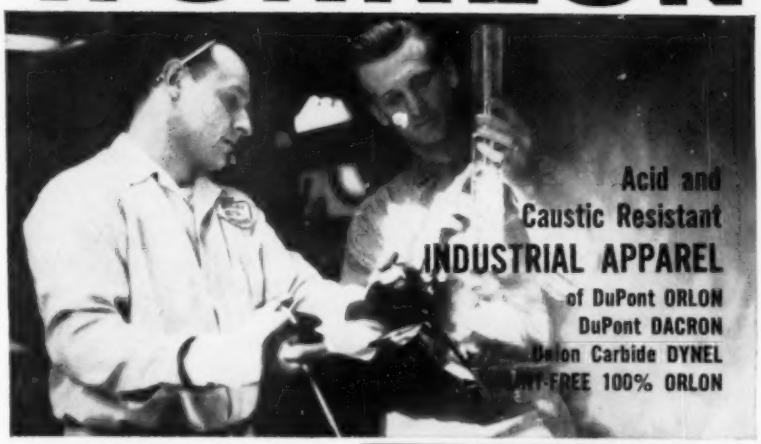

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ARTICLE REFERENCES

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Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

103. APPLICATIONS

a. *NUTS AND BOLTS: PLATING TO PREVENT SEIZURE.*
W. B. Stephenson Jr.
Products Finishing, July 1958, pp. 38–42.

104. COPPER

a. *GRAIN GROWTH AND FLECKING IN ELECTROPLATED COPPER CAUSED BY CYCLIC STRESS.*
H. Okubo and N. Nozaki.
Journal of the Electrochemical Society, July 1958, *105*, No. 7, pp. 384–388.

105. ELECTROPOLISHING

a. *ELECTROPOLISHING SILICON IN HYDROFLUORIC ACID SOLUTIONS.*
Dennis R. Turner.
Journal of the Electrochemical Society, July 1958, *105*, No. 7, pp. 402–408.

106. ENGINEERING

a. *REINFORCED PLASTICS IN THE PLATING AND ACID TREATMENT INDUSTRIES.*
Electroplating and Metal Finishing, April 1958, *11*, No. 4, pp. 111–114.

107. FINISHING

a. *THIRD NATIONAL COATED ABRASIVE MACHINERY SHOW IN REVIEW.*
Ezra A. Blount.
Products Finishing, July 1958, pp. 65–70.

108. MISCELLANEOUS

a. *POINTING OUT PLUSES OF FINE-GRAIN PLATING.*
Chemical Week, *82*, March 22, 1958, pp. 29, 32.
"Fine grain is achieved by depositing the Ni from a standard nickel sulphate bath, containing no organic additives, onto a mandrel coated with about 15 per cent (by weight) resinous binder (e.g. plasticized vinyl) and 85 per cent conductive material (e.g. graphite, powdered metal) having extremely small particle size."

b. *WATER—ITS USE IN THE PLATING SHOP.*
Lester F. Spencer.
Metal Finishing, July 1958, *56*, No. 7, pp. 44–51.

109. NICKEL

a. *EFFICIENT DRAG-OUT RECOVERY IN BARREL NICKEL PLATING.*
R. J. Maling.
Electroplating and Metal Finishing, June 1958, *11*, No. 6, p. 184–189, 206.

b. *VAPOR PLATING OF NICKEL.*
L. W. Owen.
Metal Industry, *21*, March 1958, pp. 227–230.
"Nickel coating from nickel carbonyl vapor. Design of equipment."

c. *MULTILAYER NICKEL COATINGS.*
Metal Progress, June 1958, *73*, No. 6, pp. 95–96.

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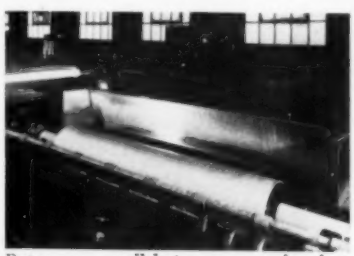

Rotogravure roll being copper-plated at the *St. Louis Post-Dispatch*.

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110. ORGANICS

a. *SCIENCE FOR THE COATINGS TECHNOLOGIST. PART X. PAINT ADDITIVES—ANTI-SETTLING AGENTS.*
E. S. Beck.
Metal Finishing, July 1958, *56*, No. 7, pp. 56–59.

b. *DIP PAINTING AND FLOW COSTING. SOME POSSIBILITIES CONSIDERED.*
Mark Reeves.
Electroplating and Metal Finishing, April 1958, *11*, No. 4, pp. 105–109.

111. PHOSPHATING

a. *PHOSPHATING TREATMENTS. A COMPREHENSIVE PATENT LITERATURE SURVEY. PART IV.*
Ervin C. Tinsley.
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112. PLASTICS

a. *PLASTICS.*
The Iron Age, June 26, 1958, *181*, No. 26, pp. 81–96.

113. POWDERS

a. *ELECTROLYTIC IRON POWDERS—PRODUCTION AND PROPERTIES.*
W. M. Shafer and C. R. Harr.
Journal of the Electrochemical Society, July 1958, *105*, No. 7, pp. 413–417.

114. STRESS

a. *FACTORS AFFECTING RESIDUAL STRESS IN ELECTRODEPOSITED METALS. A CRITICAL EVALUATION.*
Joseph B. Kushner.
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115. THEORETICAL

a. *FUNDAMENTALS OF THE THEORY OF ELECTRODES AND GALVANIC CELLS.*
Erich Lange.
Journal of the Electrochemical Society, July 1958, *105*, No. 7, pp. 420–428.
The following are Metallurgical Abstracts taken from The Journal of The Institute of Metals, April 1958, p. 619.

b. *DETERMINATION OF SULPHURIC ACID IN COPPER ELECTROPLATING BATHS WITH THE SODIUM CARBONATE-METHYL ORANGE REAGENT.*
L. Moore (Chem. and Ind., 1957, (27), 951–952).—Letter.

c. *DETERMINATION OF SULPHURIC ACID IN COPPER ELECTROPLATING BATHS.*
K. A. Wickham.
L. Moore (Chem. and Ind., 1957, (34), 1154–1155)—Letter.

d. *THE ELECTROPLATING OF ALUMINUM.*
H. W. Dettner (Aluminium, 1957, 33, (10), 665–668).—A review of the literature (mainly patents) covering processes for the electroplating of Al with Cu, Ni, Cr, etc. In most modern processes the oxide film on the surface of Al is dissolved in a special bath and its place taken by a thin film of Cu or Zn, upon which any desired metal can be subsequently deposited.

e. *ON THE TWIN STRUCTURE OF NICKEL FILMS ELECTRODEPOSITED ON SINGLE CRYSTALS OF COPPER.*
Shiro Ogawa, Joji Mizuno, Denjiro Watanabe and F. Eiichi Fujita (J. Phys. Soc. Japan, 1957, 12 (9), 999–1006). (In English)—Single-crystal-like Ni films were examined by electron diffraction and electron microscopy after they were detached from the substrates. Films deposited on faces (110), (001) and faces with higher indices were observed and showed epitaxy and marked twin structures. Films deposited on electropolished gave a very much coarser twin structure of very much larger lamellae than those deposited on etched surfaces.

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The domestic cost of the book is $10 per copy including postage. To those ordering it from outside the United States' continental limits, the charge is $12 per copy including postage cost. All orders must be accompanied by payment in full so as to obviate unnecessary bookkeeping expense. Address orders to:

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A very limited quantity also exists of the 1956 Edition. Domestic price is $12.50 per copy; foreign $15 per copy. All orders must be accompanied by payment in full.

PERSONALS

H. A. Evangelides

W. J. Hennessy

Harry A. Evangelides is now a member of the firm of Western Sealant Metal Finishing Co. Philadelphia.

He was formerly with the Pitman-Dunn Laboratories of the Frankford Arsenal in Philadelphia, primarily interested in anodic coatings for the protection of magnesium. The HAE process was the result of his studies.

In his new capacity he will be available for consultation on metal finishing problems. He is a member of the AES, American Chemical Society, Research Society of America and the American Ordance Association.

Frank W. Weldon has been appointed District sales manager for Kelite Corp. Prior to his appointment, Mr. Weldon served for 12 years with Oakite Products, Inc.

He will be responsible for sales in the Dallas District, comprising northwestern Texas, Oklahoma, southern Kansas, southwestern Missouri, northern Arkansas, western Tennessee and Kentucky, and northern Mississippi. He will make his headquarters at Kelite's Dallas facility.

Eugene L. Sommers has been elected president of Sommers Brothers Manufacturing Co., St. Louis, Mo. to carry on in the position formerly held by his uncle, Carl J. Sommers, who died on May 5, 1958.

Peter J. Cambourelis has been appointed technical assistant to the director of product development, Solvay Process Division, Allied Chemical Corp.

A graduate of Massachusetts Institute of Technology, Mr. Cambourelis holds a BS degree in business and engineering administration. Before joining Solvay, he was a sales engineer for Rem-Cru Titanium, Inc.

In his new position, he will be located at 61 Broadway, New York City.

William J. Hennessy has been appointed national product development manager for Kelite Corp., manufacturer of industrial chemicals for cleaning and metal finishing, and steam cleaning equipment.

Mr. Hennessy has been a district sales manager and later eastern regional sales manager for Kelite. Prior to joining Kelite, he served for more than 20 years in various sales and sales management positions for Pennsalt Chemicals Co. He is a member of the American Electroplaters' Society, and is past-president of the Pittsburgh Branch.

Mr. Hennessy has his office in Philadelphia, and resides in Glenside, Pa.

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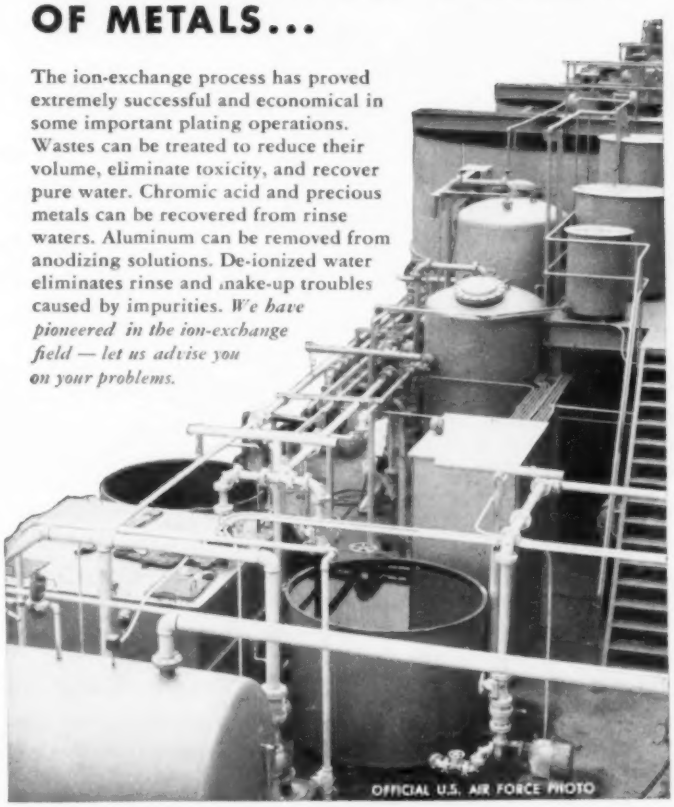

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BOEING

C. C. Brumbaugh, director of engineering for Diamond Alkali Co. since June, 1954, has been appointed a vice president.

In his new post, Mr. Brumbaugh's sphere of influence will be the engineering, research and related technical aspects of Diamond's business.

Named to succeed Mr. Brumbaugh as director of engineering is **Robert C. Sutter,** operations manager of Diamond's Chlorinated Products Division for the past year and a half.

Mr. Brumbaugh, associated with Diamond for the past 21 years, has played an important role during this period in developing and furthering the Company's engineering and research program. He is the inventor of five important processes presently used by Diamond and holds a number of minor patents.

Mr. Sutter, Diamond's new director of engineering, is another veteran employe. He joined the company in 1940 after earning a chemical engineering degree from Fenn College and since then has handled a number of special engineering and operating assignments for Diamond.

In 1942 he was named superintendent of the hypochlorite plant at Diamond Magnesium Co., Painesville, returning to Diamond Alkali three years later. He was appointed chief group engineer for the Central Engineering Department's Painesville staff section in 1954, became assistant director of engineering the following year, and was made operations manager of the Chlorinated Products Division in 1957.

Herbert S. Kishbaugh is now assistant manager, New York Sales branch, Solvay Process Division, Allied Chemical Corp.

A graduate of the University of Tennessee, Mr. Kishbaugh holds a BS degree in business administration. He joined Solvay's advertising department in 1948, moved to the Boston branch as a salesman the following year and was assigned to the New York sales branch in 1956.

In his new post, Mr. Kishbaugh will be located at 261 Madison Avenue. He will assist in the management of Solvay sales activities in the Metropolitan Area and New Jersey.

Robert I. Peters has been appointed assistant chief engineer, **R. E. Scheel** named western sales manager and **R. A. Brown** appointed Chicago sales engineer of Heil Process Equipment Corp.

Mr. Peters, who has been with the company during the past 12 years as estimator, sales engineer, and more recently as western division sales manager, is a graduate of Fenn College in mechanical engineering, and is also president of the Cleve-

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A limited extra quantity of the book is still available at National Headquarters for the accommodation of Branches that have not previously ordered copies. These will be sold to Branches (only), on a first-come, first-served basis so long as that supply lasts, at $5.50 per copy, including postage to one destination.

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R. E. Scheel

R. I. Peters

land Branch of the American Electroplaters' Society.

Mr. Scheel, who graduated from Ohio University, has been with the company 8 years, first in Cleveland and more recently in Chicago as district sales engineer.

Mr. Brown, a graduate in mechanical engineering from the University of Michigan, was formerly district engineer in the Detroit Office.

John E. King has been appointed sales manager of J. W. Rex Co., Lansdale, Pa. Consultants and specialists on modern metal processing, the company includes precision heat treating, aluminum anodizing and alodizing, and commercial spray painting among its services.

H. C. Sohl has been named to the research and development center of Alpha Metals, Inc., Jersey City, N. J.

Mr. Sohl has had over ten years experience with the American Smelting & Refining Co.

S. Mitwol

P. Harper

Sid Mitwol has been promoted to general manager, Rectifier Division of Sel-Rex Corp., Nutley, New Jersey. In his new position, Mr. Mitwol will be responsible for all the activities of the division, including sales, manufacturing and new product development.

Having joined Sel-Rex in 1948 as sales engineer, Mr. Mitwol has progressed through positions of increasing executive responsibility, and was manager of the firm's Detroit office prior to his current assignment.

A graduate electrical engineer of C. C. N. Y.'s School of Technology, Mr. Mitwol was formerly associated with Federal Telephone and Radio Co. and Radio Receptor Co., Inc.

General manager, Rectifier Division, is a new position created to better coordinate all the Division's efforts and to permit closer liaison with Sel-Rex manufacturer's representatives and distributors. Mr. Mitwol will make his headquarters at the firm's general offices in Nutley.

Paul Harper has been appointed West Coast representative for Sel-Rex Corp., Nutley, New Jersey.

A graduate chemical engineer, University of Missouri 1939, Mr. Harper has been active in the electroplating and metal finishing industries for nearly 20 years, having held such positions as: manager of plating division, Michigan Chrome and Chemical Co., Detroit; plant manager, Detroit Die Casting Co., Detroit; plant manager, Bart Manufacturing Corp. and process engineer for Western Cartridge Co., Division of Olin-Mathieson Chemical Corp.

During World War II, Mr. Harper was assigned by his employer, Chrysler Corp., Detroit, to the Manhattan Project where he was concerned with the fabrication of diffusion equipment for the Atomic Energy installation in Oak Ridge, Tennessee.

In his new post, Mr. Harper with headquarters in Los Angeles, is responsible for sales and technical service in the states of California, Oregon, Washington, New Mexico, Nevada, Texas, Utah, Arizona and Colorado.

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Service: 100% Sure

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1—7500/3750 AMPERE, 9/18 VOLT, **H-VW-M,** Synchronous.
1—7500/3750 AMPERE, 6/12 VOLT, 25° C., **CHANDEYSSON,** Synch.
1—6000/3000 AMPERE, 6/12 VOLT, **ELETRIC PRODUCTS,** Synch.
1—5000/2500 AMP. 9/18 VOLT 25°C **CHANDEYSSON,** Synch. Exciter-in-head.
1—5000/2500 AMPERE, 6/12 VOLT, 25° C., **CHANDEYSSON,** Synch.
1—4000/2000 AMPERE, 6/12 VOLT, **H-VW-M,** Synch., Exc.-in-head.
3—3000/1500 AMPERE, 12/24 VOLT, **CHANDEYSSON,** Exciter-in-head.
1—2000/1000 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING.**
1—1500/750 AMPERE, 12/24 VOLT, **CHANDEYSSON,** Synchronous.

ANODIZERS

1—1000 AMPERE, 40 VOLT, **CHANDEYSSON,** 25/C.
1—1000 AMPERE, 30 VOLT, **IDEAL,** Exciter-in-head.
1—750 AMPERE, 60 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous, Exciter-in-head.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON,** Synchronous, Exciter-in-head.
4—400 AMPERE, 40 VOLT, **M. G. C.,** Separately Excited.

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1—**G. E.** 2000/1000 AMPERE, 6/12 VOLT.
1—**SEL-REX** SELENIUM, 1200 AMPS., 9V, for 440/3/60.
1—**UDYLITE-MALLORY,** 1500/750 AMPERE, 6/12 VOLT.
4—**UDYLITE-MALLORY,** 1440/720 AMPERE, 6/12 VOLT.
1—**RAPID** 1500 AMPERE, 9 VOLT, Germanium Remote AVS 220/440/3/60.
1—**RAPID** 1000 AMPERE, 12 VOLT, Germanium, 440/3/60.
1—**RAPID** 750 Amp., 6 V Selenium, Remote Control, 440/3/60 AC.
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4—No. 2H **BAIRD** Poliaction Tumblers.

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Robert R. Kindron has been promoted to technical assistant to the New England sales manager of Becco Chemical Division, Food Machinery and Chemical Corp., Buffalo. He will work out of Becco's New England office, on Fountain Street, Framingham, Mass.

Mr. Kindron, a graduate of Canisius College, joined Becco in 1947 as a research chemist. Since 1953, when he became a sales representative, Mr. Kindron has been based in the New England area.

Anthony DePhillips has been named as assistant branch manager of the Philadelphia branch sales office of Diamond Alkali, Co., Cleveland, Ohio.

Mr. DePhillips, who has already assumed his new responsibilities, succeeds the late George J. Soren.

A member of the company's Philadelphia sales staff covering the Baltimore, Md., area since 1937, Mr. DePhillips has been associated with Diamond in a sales capacity for nearly 30 years.

THEODORE N. GASSEN

As it must to all men, death came on July 26, 1958, to Theodore N. Gassen, 49, in Detroit, Michigan.

Ted Gassen had been actively engaged in the plating industry for thirty-two years and through his association with the Detroit Branch of the American Electroplaters' Society he made many friends from all parts of the country.

Ted had been associated with the Ternstedt Division, General Motors Corporation for the past twenty-three years during which time his ambitions and responsibilities steadily increased until he was considered an authority in the field of electroplating, and counsel to the less informed was never denied.

His outside activities included practically all sports and he was active in baseball, bowling and golf.

Ted Gassen will be greatly missed by his many friends and associates and his good nature and strength of character will be long remembered by all who knew him.

PREVIEW OF FUTURE PLATING ISSUES

●

NOVEMBER 1958

AIRCRAFT. Electroplating and metal finishing in the aviation industry will be featured in this second annual edition.

●

THE OCTOBER and DECEMBER issues loom as strong 1958 General Issues.

●

JANUARY 1959

ABRASIVES AND MECHANICAL FINISHING. Developments in the various finishing methods will be featured in this annual issue.

●

MARCH 1959

ORGANIC COATING. The importance of organic finishing to electroplaters is increasing rapidly. New and review material will be presented.

●

JUNE 1959

GOLDEN JUBILEE. A large feature issue climaxing the Fiftieth Anniversary observance of the American Electroplaters' Society, PLATING's parent, it will be targeted both for immediate interest to PLATING's global circulation and for long retainment as an AES reference source and as a memento of this year-long observance.

BRANCH NEWS

Total AES Branches U. S., Canada Australia, August 1, 1958—58.

MILWAUKEE
Pinner Presents Paper; Racine Meeting Planned

The 190th regular meeting of the Milwaukee Branch was called to order by President **E. H. McCoy** on June 4, 1958 at the Pabst Blue Ribbon Hall following the Eighth Annual Pabst Blue Ribbon Dinner. The Milwaukee Branch was honored by the twenty-fourth annual visit of **Walter L. Pinner.**

Delegate **Phil Ritzenthaler** reported on accomplishments at the National Convention.

The formation of a Midwest Regional Council was approved consisting of the Milwaukee, Chicago, Mississippi Valley, St. Louis, St. Joe Valley, Twin City and Rockford Branches. Bylaws were presented and must be ratified by the respective Branches.

Milwaukee was chosen as the site of the National Convention in 1962. This will be a Midwest Regional function.

After **Ray Goodsell** reported that plans for the Annual Racine Meeting were well on the way, the chair was passed to **Glen Schwemmer,** chairman of the Pabst-Pinner Dinner. Mr. Schwemmer introduced guest **John Anglim,** Pabst Host **Walter Kessler,** representatives of neighboring AES Branches and Walter L. Pinner.

Mr. Pinner presented a paper, supplemented with slides, on the latest findings observed by the ASTM Committee B-8 which is making corrosion tests for the performance of electrodeposited metal coatings. The color slides graphically showed the result of corrosion on test panels located in Florida, New York and Detroit atmospheres. Some interesting conclusions seems evident:

1. Supposedly identical panels prepared by different sources did not have identical results in most cases presented.
2. Panels, where Watts nickel was used in a copper-nickel-chrome system, had comparable results irrespective of the plating source.
3. Watts nickel appeared to be better than bright nickel.
4. There seems to be no beneficial effect by buffing bright nickel.
5. Nickel on steel, buffed and plated with a second coat of nickel and then chrome plated gave better corrosion protection than the usual copper-nickel-chrome system.
6. Two, three and six times the normal amount of chromium plate was far superior in preventing corrosion than any system under test.

The final order of business was the installation of the new officers by Walter Pinner.

S. Taterzynski
Secretary-Treasurer

SAN FRANCISCO
Ruhly Speaks on Masking; Seven Members Elected

The July meeting of the San Francisco Branch was held at the International Inn, South San Francisco, Calif.

In attendance were 21 members and 13 guests. This was the best turn out for the 1958 year.

Our speaker was **King Ruhly** of Michigan Chrome who gave a very instructive talk on "Masking and Stop-Off Problems." With Mr. Ruhly was the West Coast representative for Michigan Chrome, **Al Neeme.**

During the business session seven applicants were elected to membership.

R. T. Coen
Secretary-Treasurer

AES MEMBERSHIP REPORT

ELECTIONS

Baltimore-Washington: R. R. Clow, H. R Gleim, W. M. Toombs

British Columbia: H. J. A. Launder

Chicago: A. Alexander, D. W. Brown, D. S. Burnette, W. M. Davis, H. J. Harrast, W. A. Mercer, D. P. Phillips, J. J. Trutty, R. J. Vanderplow

Grand Rapids: J. De Liefde, R. O. Knudson, E. Krampe

Melbourne: V. E. B. Cousins, A. Dyring, L. A. Venn

Milwaukee: R. A. Rohs, E. J. Skidmore, T. G. Wirth

Portland: R. Morseth

Rockford: R. M. Legge, E. A. Owen, M. B. Small

Saginaw Valley: J. Neymeiyer

San Francisco: S. R. Bammann, G. T. Coleman, M. L. Hart Jr., H. Henderson, J. E. Hodges, F. G. Hutchinson, B. E. Kelly, L. G. Larsen

Southeastern: W. D. Buice, J. N. Hutchins

Twin City: L. J. Cerrotta, E. V. Gillaspy, B. L. Miller, J. Mitchell, E. L. Young

Member-at-Large: G. Arnold Jr., Springfield, Missouri; E. R. Conder, Nogales, Arizona; A. H. Smith, Surrey, England.

REINSTATEMENTS

Chicago: A. J. D'Anna

Cleveland: A. Pope, K. Prentice, F. A. Rometti, L. C. Sobey

TRANSFERS

Chicago: J. K. Harlow to Columbus, F. H. Meller, to Rockford

Hartford: J. T. MacDermid to Springfield

San Francisco: H. Smallman from Los Angeles

RESIGNATIONS

Chicago: L. N. Peterson

Cincinnati: E. E. Smith

Detroit: C. B. Black, J. F. Parr

Grand Rapids: M. A. Felix, W. J. Gavin Jr.

Hartford: J. E. Beloin, J. St. Pierre

Indianapolis: R. K. Niederjohn

Melbourne: B. Ogle, N. McLeish, J. N. Reeves

Milwaukee: S. R. Borucki, L. E. Carr, C. F. Colley, P. W. Emley, W. Guenther, A. B. Pope, S. R. Warwick

Philadelphia: F. M. Beausang

Twin City: R. Cross

SUSPENSIONS

Hartford: R. J. Frechette, J. Hartl, A. Thomforde, E. Weich

Melbourne: J. T. Chapple, A. Chesterfield, D. W. Donaldson, J. N. Flavell, J. N. Lynch, J. C. Parkin, G. Partell, K. W. Peacock, F. R. Richards, O. B. Simon, R. D. Slade, R. D. Taylor, T. P. Williams

Milwaukee: A. Butschke, R. T. Coyle, H. Kaltenbach

Saginaw Valley: E. S. Meade Jr.

Southeastern: M. Courvoisier, D. Doenges

DEATHS

Twin City: Mark Murphy

CLASSIFIED ADVERTISEMENTS

Only "Help Wanted" and "Situations Wanted" will be accepted. Rates: $.20 per word, minimum $5.00. AES branch members and members-at-large only, in good standing, are entitled (for personal use only) to a total of three free advertisements in any twelve-month period as of first insertion. Last day for inserting advertisements is the 10th of month preceding date of publication. When answering advertisements please address as follows: Box number, PLATING, 445 Broad Street, Newark 2, N. J.

SITUATIONS WANTED

CHEMIST—ELECTROCHEMIST. Age 36, B.S. degree. Experience in plating and finishing processes, development-research, process design, production and control. Extensive experience in metallizing and plating on plastics, printed circuitry, automatic plating, electroless plating, noble metals, cleaning. Reply to Box S1, PLATING, 445 Broad St., Newark 2, N. J.

ELECTROCHEMIST, age 34. M.S. degree plus further graduate work. 5½ years experience research and development and 2 years experience production in plating on aluminum, electrodeposition lead alloys, copper, nickel, chromium and zinc. Desires "job with a future" in research and development. Reply to Box S2, PLATING, 445 Broad St., Newark 2, N. J.

PLATING CHEMIST, Industrial Chemistry Diploma. Age 27—five years experience in electroplating (government and private enterprises) includes control, research, troubleshooting, metallurgy and metallography. Have knowledge and experience in aircraft materials and metal working. Prefer Metropolitan area. Will consider relocation. Reply to Box S3, PLATING, 445 Broad St., Newark 2, N. J.

METAL FINISHING ENGINEER. Chemistry and Metallurgy background. Production experience in large plating plant operation. Responsible for mfg. processes, solution control, trouble shooting and cost reduction. Desires Technical Service-Sales position. Reply to Box S4, PLATING, 445 Broad St., Newark 2, N. J.

FOREMAN—Plating and Spray painting, experienced with Cadmium, Zinc, Copper, Tin and painting on metals and plastics. Reply to Box S5, PLATING, 445 Broad St., Newark 2, N. J.

PLATING SUPERINTENDENT with 21 years experience. 41 years old, married, 2 years college credit in Chemical Engineering. 11 years of strip steel plating, 5 years electropolishing and 3 years of hard chrome plating. Some time study experience. Last 7 years as Supt. with good labor relations record. Reply to Box S6, PLATING, 445 Broad St., Newark 2, N. J.

MANAGER, age 30. Degrees in engineering and chemistry. Broad cultural and business background. Experienced in research and development administration. Excellent training in electrochemistry. Desires challenging position as manager of technical sales or as assistant to busy executive in the electroplating industry. Presently director of large development laboratory in industry. Reply to Box S7, PLATING, 445 Broad St., Newark 2, N. J.

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FUTURE MEETINGS

AMERICAN ELECTROPLATERS' SOCIETY

September	17—**Research Committee Meeting,** National Headquarters, Newark, N. J.
September	19-20—**Executive Board Meeting,** Hotel Statler, Detroit, Mich.
September	26—**Editorial Board Meeting,** National Headquarters, Newark, N. J.
October	4—**Montreal Branch,** Annual Dinner-Dance, Queen's Hotel, Montreal, Canada.
Oct. 31-Nov.	1—**Philadelphia Branch,** Annual Educational Session and Banquet, Hotel Sheraton, Philadelphia, Pa.
December	4-5—**Detroit Branch,** Annual Educational Session and Banquet, Hotel Statler Hilton, Detroit, Mich.
December	12-13—**Newark Branch,** Annual Educational Session and Christmas Party, Hotel Robert Treat, Newark, N. J.
January 17,	1959—**Grand Rapids Branch,** Annual Educational Session and Banquet, Pantlind Hotel, Grand Rapids, Mich.
January 31,	1959—**Chicago Branch,** Annual Meeting and Banquet, Conrad Hilton Hotel, Chicago, Ill.
January 31,	1959—**Cleveland Branch,** Annual Educational Session and Dinner-Dance, Cleveland, Ohio.
February 7,	1959—**New York Branch,** Annual Educational Session and Banquet, Hotel Statler Hilton, New York, N. Y.
February 13-14,	1959—**Dixie Regional Group,** Educational Session and Banquet, Southeastern Host Branch, Dinkler Plaza Hotel, Atlanta, Ga.
February 14,	1959—**Sixth Interim Meeting,** Dixie Regional Group Sponsor, Southeastern Host Branch, Dinkler Plaza Hotel, Atlanta, Ga.
March 7,	1959—**Rockford Branch,** Annual Educational Session and Banquet, Faust Hotel, Rockford, Ill.
March 7,	1959—**Dayton Branch,** 13th Annual Meeting and Dinner-Dance, Dayton, Ohio.
April 4,	1959—**Fifth Tri-State Regional,** Louisville Host Branch, Louisville, Ky.
April 11,	1959—**Baltimore-Washington Branch,** Annual Banquet and Dance, Presentation of Pot.
April 11,	1959—**Empire State Regional,** Buffalo Host Branch, Hotel Peter Stuyvesant, Buffalo, N. Y.
April 18,	1959—**Twentieth New England Regional,** Waterbury Host Branch, Hotel Statler, Hartford, Conn.

(*Continued on next page*)

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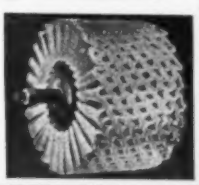

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(Continued)

April 25, 1959—**Milwaukee Branch,** Annual Meeting and Banquet, Schroeder Hotel, Milwaukee, Wis.

June 15–18, 1959—**Golden Jubilee Convention and International Exposition, Including Fifth International Conference on Electrodeposition and Metal Finishing,** Convention Headquarters—Hotels Statler Hilton and Sheraton-Cadillac, Exposition—Artillery Armory, Detroit, Mich.

July 10–14, 1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.

June 18–23, 1961—**48th AES Annual Convention,** Hotel Statler, Boston, Mass.

June 25–28, 1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

June 24–27, 1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City, N. J. Sponsorship Newark Branch.

INTERSOCIETY

September 12—**Society of Plastics Engineers,** Regional Technical Conference, St. Clair Inn, St. Clair, Mich.

Sept. 28–Oct. 2—**The Electrochemical Society,** Fall Meeting, Chateau Laurier, Ottawa, Canada.

October 27–31—**40th National Metal Exposition and Congress,** Sponsored by American Society for Metals, Cleveland Public Auditorium, Cleveland, Ohio.

November 5–6—**Society of Vacuum Coaters,** Fall Conference, Hotel Statler Hilton, Detroit, Mich.

November 18–20—**9th National Conference on Standards,** American Standards Association, Hotel Roosevelt, New York, N. Y.

January 27–30, 1959—**Society of Plastics Engineers,** 15th Annual Technical Conference, Hotel Commodore, New York, N.Y.

February 2–6, 1959—**American Society for Testing Materials,** Committee Week, Penn-Sheraton Hotel, Pittsburgh, Pa.

March 16–20, 1959—**11th Western Metal Exposition and Congress,** American Society for Metals and other technical groups, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 17–19, 1959—**National Association of Corrosion Engineers,** 15th Annual Conference and Exhibition, Hotel Sherman, Chicago, Ill.

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445 Broad Street, Newark 2, N. J.

May 3–7, 1959—**The Electrochemical Society,** Spring Meeting, Sheraton Hotel, Philadelphia, Pa.

June 21–26, 1959—**American Society for Testing Materials,** 62nd Annual Meeting, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

October 11–16, 1959—**American Society for Testing Materials,** Pacific Area National Meeting (with Exhibit), Sheraton-Palace Hotel, San Francisco, Calif.

October 18–22, 1959—**The Electrochemical Society,** Fall Meeting, Deshler-Hilton Hotel, Columbus, Ohio.

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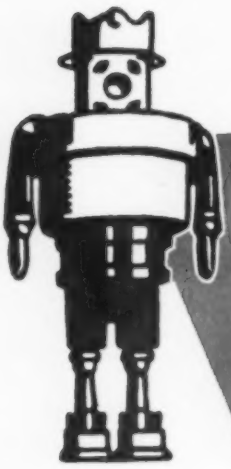

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THE SOLUTION: After extensive investigation, Cinch installed Sel-Rex Bright Gold because this patented formulation produces electroplate which is:
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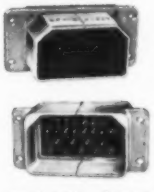
Front and rear view of 50 contact socket D sub-miniature series with floating mounting holes.

15 contact plug and socket D sub-miniature series.



23 contact plug and socket DPX series.

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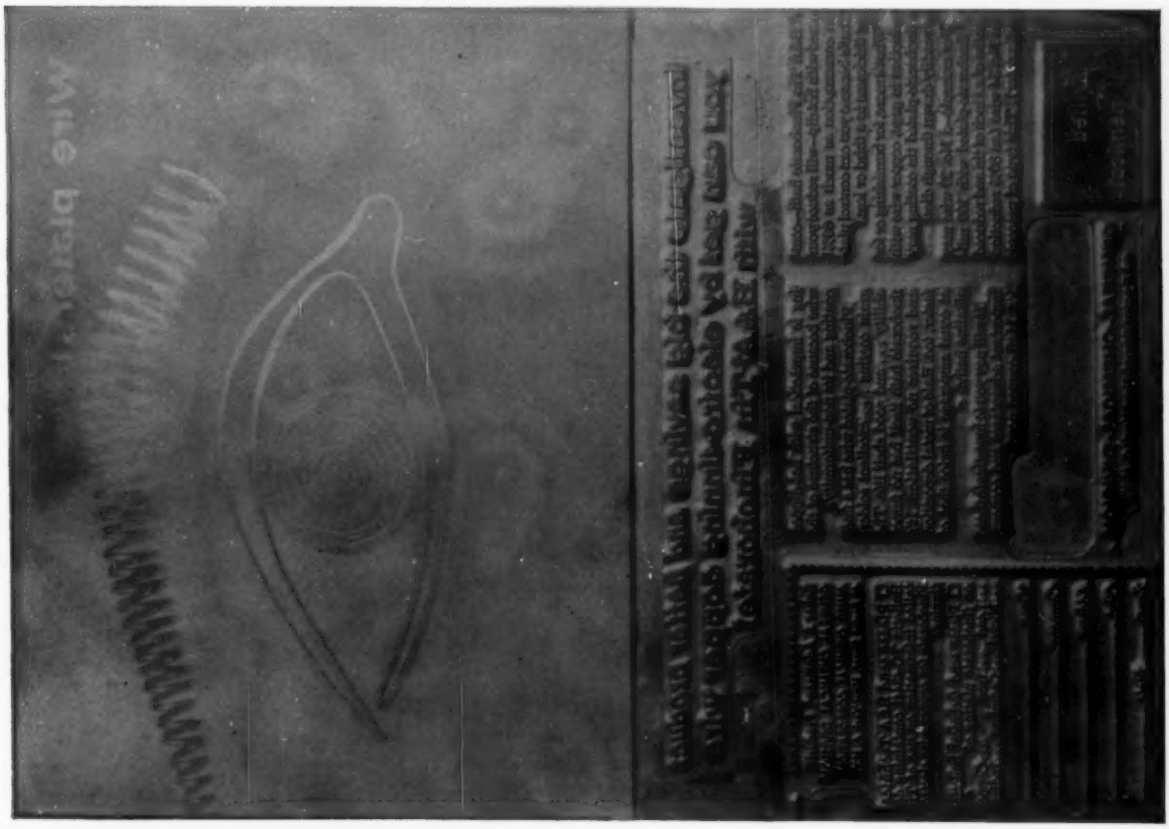

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Nickel plating of stereotypes

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When you're working against time, as most electrotypers do, you become especially aware of the great advantages offered by B&A Fluoborate Plating Solutions—which permit the use of high current density with corresponding high rates of metal deposition.

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PL-98

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